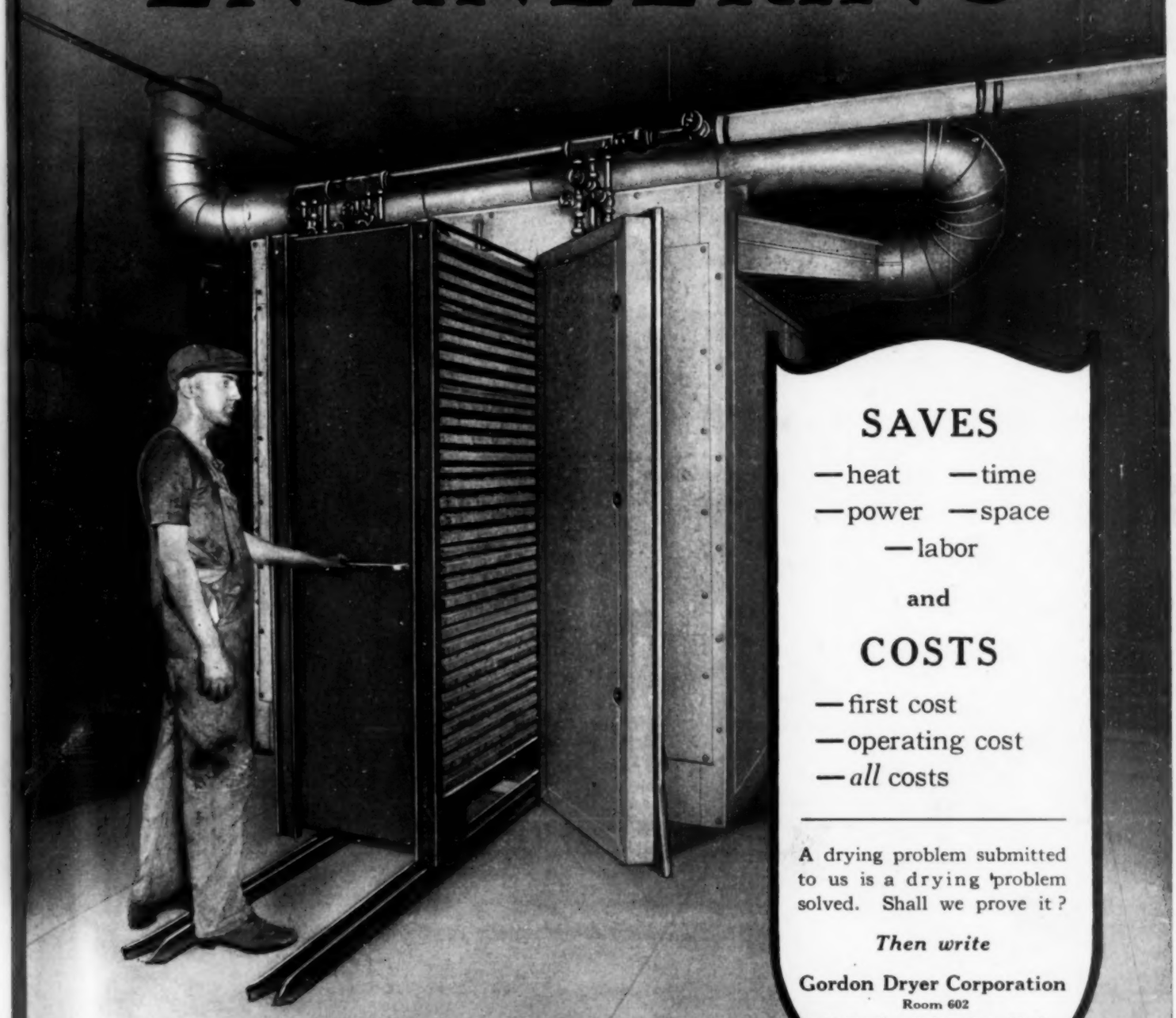
New York, August 15, 1919 McGraw-Hill Company, Inc. Vol. XXI, No. 4, 25c a copy

CHEMICAL & METALLURGICAL ENGINEERING



SAVES

—heat —time
—power —space
—labor

and

COSTS

—first cost
—operating cost
—*all* costs

A drying problem submitted to us is a drying problem solved. Shall we prove it?

Then write

Gordon Dryer Corporation
Room 602
39 Cortlandt St., New York

Gordon Dryers

For Big Production and Low Operating Cost

SHRIVER FILTER PRESSES

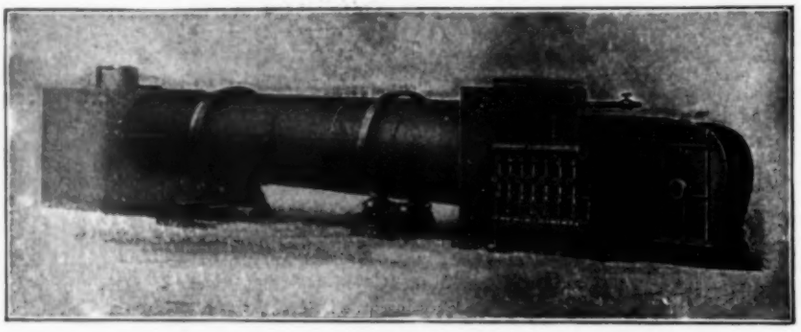
They increase output and effect marked savings in filter cloth replacements and the recovery of values. Little attendance and less wash water adds to their economy.

Have wide joint surfaces. Accurate finishing of plates and frames, coupled with an efficient tightening device, prevents leakage.

Presses for all industrial filtration. Small presses for laboratory work.

T. Shriver & Co., 808 Hamilton St. Harrison. N. J.

STEAM HEATED AIR DRYERS



for drying Borax. Nitrate of Ammonia, Baking Powder, etc.

Have equipped largest chemical plants in the world.

Also Direct Heat Dryers for By-Products.

Material carried in stock for standard sizes.

American Process Co.
68 William St., New York

The Mechanical Weather Man says:

Is "Every day a *good* day" in your business?

If not, if *weather*—hot, cold, dry, or moist—affects your process or your labor, why don't you ask me to tell you about *Manufactured* Weather—made to your order for your entire establishment?

Our apparatus is supplying more than four hundred million pounds of made-to-order weather every day, to more than two hundred distinctly different American Industries, from chewing gum to aeroplanes.

Bulletin 100-E is yours for the asking.

Write right now!

Manufacturers of Weather Humidification, Dehumidification, Heating, Cooling, Ventilation, Purification, Drying.

Carrier Engineering Corporation
39 Cortlandt Street, New York, N. Y.
Boston Buffalo Chicago Philadelphia

Published SEMI-MONTHLY *on the* FIRST *and* FIFTEENTH *of each month*

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE
Editor
ELLWOOD HENDRICK
Consulting Editor
ERNEST E. THUM
Associate Editor

WALLACE SAVAGE
ALAN G. WIKOFF
Assistant Editors
L. W. CHAPMAN
Western Editor
J. S. NEGRU
Managing Editor

Volume 21 — New York, August 15, 1919 — *Number* 4

A Thought on The General Unrest

SPEAKING in London to a group of American technical journalists who were the luncheon guests of Lord NORTHCLIFFE, Mr. W. L. HICHENS, managing director of Cammell Laird & Co., Ltd., pronounced some exceptionally sane views on the subject of employer and employee, production and wages, strikes and lockouts. They recur to mind with peculiar force in view of the epidemic of unrest which has recently manifested itself almost throughout the United States. Admitting that his company would like to maintain or even increase wages and reduce working hours, Mr. HICHENS recognized that this could be done only by increasing production, which, in turn, could be accomplished only by improving mechanical devices and by discontinuing the evil practice of restricting output. But it was in relation to labor strikes and inordinate capital profits that his words rang true when be declared that neither labor nor capital had any right "to hold the community up to ransom and pillage them by means of strong combinations." The expression is worth sober reflection by those who apparently have forgotten that "Industry ought to be at the service of the community as a whole," and that no minor class should be allowed to dictate the terms and conditions under which it will play its part in the national life. We cannot believe that the community as a whole is growing in sympathy with groups of men who, either by extortion or by threats of violence, gain an undue advantage over the balance of their fellows. Reaction must set in sooner or later, and in the long run the part of prudence must be to retain the esteem of the public.

Andrew Carnegie, Steel Manufacturer

ANDREW CARNEGIE, Laird of Skibo, philanthropist and American steel manufacturer, died on August 11 in his eighty-fourth year. Much might be said of his public and private benefactions, setting a new world record, his efforts to promote world peace and his intelligent love of art, but these things are well known. How and why he became the greatest steel maker in the world is particularly worth considering. His very first venture in business gives us one key. He had advanced from bobbin boy to stoker, to bill clerk, to messenger boy and then to telegraph operator, when his employer, Col. THOMAS A. SCOTT, division superintendent of the Pennsylvania Railroad, secured him the opportunity to subscribe for ten shares of Adams Express Co. stock at $60 a share. The Carnegie home was mortgaged for $500 and Colonel SCOTT helped young CARNEGIE on the balance. In the industrial depression of 1893-98, when iron mills had failed right and left, it was said that every bank in Pennsylvania held Carnegie paper. Of all producers the Carnegie Steel Co. was the most successful in financing the change from wrought iron to steel.

Easily ANDREW CARNEGIE'S greatest asset was his ability to judge men, and in this his instinct was unerring. At a dinner in Cleveland Mr. CARNEGIE remarked he would like to have the epitaph: "Here lies a man who knew how to get around him men smarter than himself." The Associated Press in its dispatches left out the word "him" and thus set the newspaper paragraphers gasping. It was a matter not merely of getting smart men but of putting them in precisely the most appropriate job. In any business, therefore, Mr. CARNEGIE would have succeeded, but the steel business presented the finest opportunity.

ANDREW CARNEGIE himself said, "Pioneering doesn't pay"; yet in a measure he was a great pioneer. He knew when it was profitable to adopt the new method or the new device. In SWANK'S "Iron in All Ages" there is a list of first producers of bessemer steel in the United States. Carnegie Bros. & Co., Ltd., stand No. 11 in that list, with their first blow August 25, 1875, two 7-ton converters. Twenty years or so later basic open-hearth steel had been made at many works in the United States, but then the Carnegie Steel Co. adopted the process on a large scale. Quick to seize commercial opportunities, the company secured from Alabama much of the pig iron early used in the process, under freight rates that were neither printed nor fit to print.

As the United States was taking front rank in steel production, foreign producers experienced no difficulty in seeing that the key to the success achieved was tonnage outputs. Of that religion ANDREW CARNEGIE was the high priest. It has been related that Capt. WILLIAM JONES, one of the greatest mill managers of all time, would step into CARNEGIE'S office and with pride lay before him a new tonnage record, to which CARNEGIE: "That's fine! That's fine! Can't you do better next week?" When CARNEGIE remarked to JONES what a relief he felt when New York's sky line faded from view as he sailed abroad JONES rejoined: "And you've no idea what a relief it is to us!"

That the Homestead strike of 1892 carried the low tariff political party into power was generally recognized. It was only the psychological channel through which the event operated that was open to discussion. The fairest judgment seems to be that it was not that the voter regarded the tariff as a failure in producing high wages but that the eyes of the Western voters

were opened to the high wages offered and still not acceptable. The real contest was on limitation of output. The Amalgamated Association held out for its tonnage rates when output was increased, whereby improved machinery could not earn what it was entitled to. The American steel industry would not be near where it is to-day if the Amalgamated Association had won that contest, and the total payrolls of the industry would be much less than they are.

In selling steel Mr. CARNEGIE'S ability was directly employed. For operating mills and conducting other operations he picked out men, but for years the sales policy was his own. One of his inventions was the sales arrangement that survives to this day as the contract sometimes opprobriously referred to as the "blanket" or "option" contract. He tied up large consumers with larger tonnages than they thought they would need, assuring them they would be taken care of and the contract would not be enforced to their disadvantage. Price agreements he did not keep, nor did the other parties. He played the game as it was being played in those days, more successfully and more fairly than the others.

As they are recalled in these present times some of ANDREW CARNEGIE'S methods seem different from those employed to-day, but it would be idle to assume that if he were living his business life now he would not be the most modern of the modern.

European Opinion Regarding Mexico

SECOND in importance only to the solution of domestic problems is the settlement of the Government's affairs with Mexico. If press reports are to be accepted, we may believe that the Mexican situation is about to receive official attention in Washington, with the moral backing of the principal nations of Europe. It has been no secret for some time that English sentiment has been strongly in favor of the exercise of a firm and just policy in our relations with Mexico; and if the President returns with the same impressions that other Americans receive abroad, he knows that Europe thinks we have dawdled along in our Mexican policy to the point where patience loses its virtuous qualities and becomes a byword.

On numerous occasions in the capitals of Europe, Americans have been reminded of their obvious duty in Mexico, seeing that the Monroe Doctrine prevents European nations taking a hand in American affairs. Another item tending to influence European opinion against Mexico is the unquestionable pro-German bias shown by our southern neighbor during the war, particularly in its early stages before propaganda for the truth bore fruit. Again, refusal of Mexico's request for membership in the League of Nations may be taken as a foreshadowing of European opinion on Mexico's unsatisfactory relations with other nations.

On the whole, it would seem as though all the signs point toward early settlement in some form of the demoralizing conditions that have existed for almost a decade. Whether by benevolent intervention, as in the case of Cuba, or more forcefully, in a way that Mexicans would understand, we feel that the United States owes it to her citizens and the rest of the civilized world to take steps to end an intolerable and almost farcical condition. Opinion is crystallizing through the National Association for the Protection of American Rights in Mexico, which seeks not only protection of American life and property but believes that it can also render a service to the Mexican people, who undoubtedly suffer from the chaos that has prevailed for so many years. Congressional action is indicated in resolutions recently introduced in the House and Senate relative to American claims for damages filed with the State Department, the status of our relations with Mexico, and the use of military force to protect American life and property in Mexico. With an aroused public opinion calling for official action, we have all the elements necessary for an early settlement.

Labor Research And Scientific Control

AT ITS Atlantic City meeting the American Federation of Labor adopted the following preamble and resolution:

> Whereas scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining and others, must rest; and
>
> Whereas the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers but of the whole population as well are dependent upon advances in medicine and sanitation so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and
>
> Whereas the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase, since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and
>
> Whereas there are numerous important and pressing problems of administration and regulation now faced by Federal, State and local governments, the wise solution of which depends upon scientific and technical research; and
>
> Whereas the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertakings are already active; therefore be it
>
> *Resolved,* By the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the Federal Government, and that the activities of the Government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the Federation is instructed to transmit copies of this resolution to the President of the United States, to the President pro tempore of the Senate, and to the Speaker of the House of Representatives.

This is an illuminating document, and we wish we could feel sure that the whole Federation were behind it. Without doubt it is a record of the aspirations of some of their earnest and consciencious leaders who have vision ahead of their day and generation. And it was voted through as the official expression of that great body.

The preamble contains certain principles which are more progressive than those which usually emanate from the councils of labor or those of manufacturing associations. We call attention to the statement that the development of our industries is based upon scientific research and its applications, and the merit of increasing the productivity of labor by this scientific control. It points out the "ever-increasing struggle of workers to raise their standard of living"—which is wholly in accord with their right to life, liberty and the pursuit of happiness—and it admits that under the present methods of strike and destruction the laborer does not raise himself very much after all. It holds that those who work with their hands may more effectively come into their own through scientific research. The men who framed this resolution recognize that under such research and control, workers will be called upon to meet the situation by sharper lookout and keener observation; that under the new conditions they will have to do more thinking than now, and they are ready for the new tasks.

This is the big vision, and it opens the door to democracy in industry, which is impossibie when the laborer is interested only in his pay and the employer only in getting the work done. Under real scientific control and operation the men remain men; they cease to become "hands." The administrative head knows the need of variety of work to keep up the thinking capacity, and the greater value of men who can think over those who cannot think. And where men do think about their work and how to improve it, they do so to their own greater joy and well-being.

It is not to be expected that the changelings and unwilling workers and miscellaneous incompetents may be found among these well-favored men who do difficult and skilled work. Some provision will have to be made for the stupid so that the intelligent may be able to do what they can do—and what the stupid cannot. The able men who drew this resolution must have foreseen some reasonable segregation between complete and partial men in industry.

Scientific control in its best sense is impossible unless all parties to it are honest, unless they are men who keep their word, who fulfill their contracts and whose sense of responsibility is such that they recognize their obligations to the public as well as to their immediate associates. The defective employer has been justly held up to scorn and contumely and we hope his day may soon pass. We have no sympathy for him. But it is also fair to say that those members of labor unions who are constantly calling for lower costs of living and at the same time fomenting strikes that increase these costs beyond the meanest tricks of the worst profiteers are not developed enough in intelligence or advanced enough in character to participate in this democracy in industry that should follow true scientific control. They are, to put it in plain words, not good enough.

Here and there already we find an establishment in which everybody strives for progress and each one tries to keep ahead of his job; and it is a joy to visit it! And when we find every man making a companion of his daily task and doing his best with it and where the opportunity is really open to each man to advance to the limit of his capacity, we think we begin to sense the Golden Rule of Industry.

War Department Deserts Chemical Warfare Service

PROPONENTS of the Chemical Warfare Service can appreciate the trials of JOB which led him to aver that "The thing which I greatly feared is come upon me"; for Chemical Warfare Service is to be disbanded, as we feared, and its functions are to be turned over to the tender ministrations of the Engineer Corps. The Army, speaking professionally, is against continuing the Service, just as the Army, professionally, was a close corporation, so far as Reserve Officers were concerned. Heaven alone knows, however, what the Army would have done without either or both of them. It is true that the Chemical Warfare Service probably did not cut a fine military figure, but it brought to bear on the war a knowledge of things unknown to the Army and which will continue to be a closed book if the Service is abandoned as recommended. The Chemical Warfare Service also was short on "military stuff," which is the life of the Army, but in this regard civilians will sympathize with the Reserve Officer who protested against "this military stuff in time of war" when he found it handicapped his operations.

Nevertheless the War Department, with a fine disregard for the future, is pursuing a plan which will practically throw into the discard a vast amount of knowledge, actual and potential, merely because the war is over. It is going counter to the recommendations of officers of high rank who believe thoroughly in the specialized organization of the Chemical Warfare Service, and who know how difficult it will be to recover the ground lost by inaction if the Service is abandoned. General SIBERT testified at a hearing before the Senate Committee on Military Affairs that in his opinion the Chemical Warfare Service could not be taken care of as well by the Corps of Engineers as by a separate bureau. He said he did not think engineer officers detailed for tours of duty on rivers and harbors, on fortifications and with troops, were qualified to handle chemical warfare. Lieutenant-Colonel, formerly Brigadier-General, AMOS A. FRIES told the committee that he had come back on temporary order from General PERSHING to present the need of maintaining the continuance of the Chemical Warfare Service after the war.

We recognize that the Engineer Corps constitute a small although brilliant and able branch of the U. S. Army, but they are not chemists. The matter might as well be vested in the Supreme Court, which also contains brilliant and able men, or even better in the Department of Agriculture, for competent chemists are to be found there. The Engineers cannot organize gas warfare when it is needed, because if anything has been proved by the war it is that it takes special practice among chemists to accomplish special results. We have heard manufacturers say, "Oh, we can hire chemists"—indicating that any man with a diploma could give them what they needed—for many years past until, as in England and France, the chemical side of our industries was neglected, and the Germans got the business. Chemical Warfare Service is a branch of the Army that cannot function save under constant practice.

We have given this matter careful consideration, and it is with neither heat nor emotion that we express our opinion that the War Department is seriously in error in the plan about to be adopted.

Western Chemical and Metallurgical Field

Notes on Metallurgical Activities in British Columbia

AN INVESTIGATION of ore-smelting charges in British Columbia, aimed particularly at the Trail smelters' schedules, has been dragging along for several months. After considerable agitation, a committee of four was appointed and held its first meeting at Nelson on Jan. 21, taking evidence from one mine owner in a closed session, then adjourning to meet later at Trail to discuss with the smelter officials the scope and ways and means of the investigation. Considerable objection has been voiced by mine owners to the present inquiry, and they have largely declined to co-operate with the committee, claiming that its personnel is unrepresentative and its powers so limited that no real benefit can result from its activities. Meantime the smelter management, having reduced smeltermen's wages 25c. per day, notified lead miners that the base rates effective April 15 would be reduced from $8.30 to $7.85 per ton.

The Consolidated Mining & Smelting Co.'s research department has been able to solve satisfactorily the metallurgical treatment of the complex lead-zinc ore from its Sullivan mine, an accomplishment of the utmost importance, making available an enormous tonnage of hitherto undesirable ores. Revision of the ore-dressing and metallurgical treatment in the zinc plant has already been started. On account of the added amount of blister copper to be refined which will result from the Canada Copper Corp.'s concentrates, the electrolytic refinery must also be enlarged to 50 tons daily capacity. A rod mill is also considered as a necessary adjunct in order to market this amount of copper in Canada.

Rapid progress in the new plant of the Canada Copper Corp. has been made. This company owns the Greenwood smelter, containing 3 blast-furnaces and 2 converters with a nominal capacity of 950,000 tons of ore per year. Operations have been spasmodic, however, blowing in for a short campaign whenever sufficient ore had accumulated. Thus but 2,200,000 lb. of copper was recovered in 1918, the plant finally shutting down when its principal ore supply, the Mother Lode mine, was exhausted. Since dismantlement of the smelter would be disastrous to the city of Greenwood and its environs, a citizens' committee has been endeavoring to raise the necessary funds to take over the plant and treat ores from the surrounding regions. The company has offered its plant to the committee at $125,000, a very favorable figure in comparison to its value as a going concern; on the other hand, its sale would relieve the present owners of very considerable charges for taxes and insurance. All operations of the Canada Copper Corp. have therefore been removed to its Copper Mountain deposits, whose development is costing approximately $2,500,000. About 12,000,000 tons of 1¾ per cent ore has been blocked out, and a crushing plant and ore storage bin have been built at the mouth of the main haulage system. A 2000-ton concentrator is being built at Allenby, some 5 miles south of Princeton, and is expected to be in operation during the present summer. Its construction has been seriously delayed by non-completion of the 13-mile railroad connection to the Canadian Pacific. During May the workmen employed by the grading contractor struck for an advance in pay, and work was not resumed for a month. Electricity will be had through a 103-mile extension of the West Kootenay Power & Light Co.'s lines, thus serving a consumer located 180 miles distant from the power house. Smelting and refining will be done at Trail.

Granby followed the lead of smelters in the States and posted notices of reduction of wages, following the drop in copper. Their employees at Grand Forks agreed to work for the Butte scale, effective March 1. However, the wage agreement was quite complicated, providing for a bonus of 50c. a day until wholesale prices of living necessities were reduced, a 10 per cent reduction on purchases made at the company store, and a decrease in charges for board. Employees at Anyox were not anxious to accept a reduction in wages, and during the parleys a fire burned a portion of the smelter building, causing $50,000 damage and a shutdown for a month. Upon reopening, a considerable shortage of labor was experienced, but in time most of the vacancies were filled by returned soldiers. Since April 1, however, wages have been increased twice by the Granby company, and now are at about the same figure as at the beginning of the year.

British Columbia's first by-product coke plant was started at Anyox in June. Coal is furnished by Granby's own mines, near Nanaimo, and the resulting coke is consumed in its copper blast-furnaces. Tar is shipped to Vancouver, where a distillation plant separates the valuable fractions.

Company Reports

Jackling Porphyries.—The accompanying tabulation presents comparative milling data taken from the annual reports of the so-called Jackling Porphyries, viz.: Utah Copper Co., Nevada Consolidated Copper Co., Chino Copper Co. and Ray Consolidated Copper Co. Additional information as to operations and improvements are given below.

Utah Copper Co.—As is well known, this company operates two very large concentrators near Salt Lake City. A comparative statement of its tonnage is as follows:

	Magna	Arthur
Total tons concentrated	6,625,000	5,535,700
Daily treatment	18,151	15,166
Rated capacity	12,000	16,000
Extraction	57.9%	73.4%
Cost per ton, 1918	$0.80	$1.08
Cost per ton, 1917	$0.62	$0.78

Near the end of 1918 the new primary crushing plant at Arthur mill was put into operation. It includes a car dumper and electric haulage system, a very large crusher, a complete conveying system and two additional 72 x 20-in. rolls. This scheme overcomes all difficulties in handling frozen, wet, or very large blocks of ore. Similar work is under way at the Magna plant, which, with additions to the fine grinding plant and concentrating department, will double the rated capacity of the latter and materially increases its low extraction now due in part to serious overcrowding. As a matter of fact, the average recovery of both mills for 1918—65.1 per cent—is nearly a record and is especially noteworthy in comparison with the figure for 1917—61.1 per cent—which established a minimum.

The leaching plant above Magna operated throughout the year, handling little more than a third of its rated daily capacity of 3000 tons, owing to an inadequate precipitation and drying system. The ore treated is oxidized copping averaging 0.67 per cent copper soluble in dilute H_2SO_4. Recovery amounted to 11.1 lb. per ton, of which only 10.6 lb. was precipitated and marketed in the form of cement copper, 48.8 per cent pure. Five pounds of 60 deg. Bé. acid was consumed per lb. of copper recovered. The cost of milling, leaching, precipitating, handling tailings and general expense at the leaching plant averaged $1.06 per ton, or almost exactly 10c. per lb. of copper. Crediting an allowance for copper in stock solutions, and adding smelting and selling charges, Mr. Gemmell estimates the copper from the leaching plant as costing 15.1c. Apparently no charge is made for mining, since this ore overlays the sulphide ore and its mining cost is absorbed by the stripping charge. Supposing, however, that mining actually cost 45c. per ton, the cost of cement copper would be increased from 15.1c. to 19.3c. Apparently, then, the managing director's optimistic statements as to the leaching operations refer only to oxidized ore which is moved for stripping and which requires no further handling before delivery to the mill. This view is corroborated by the fact that the leaching plant was closed Jan. 1, 1919, the first department to experience curtailment.

Chino Copper Co.—Chino's recovery of 63.3 per cent was the lowest in its history, and reverses the record of 69.3 per cent made during the previous year. This is attributed to the necessity of mining ores containing undue percentages of oxidized copper, to a shortage of skilled labor and a failure in water supply. All alterations in the old mill were finished, and the new section 6 was started in February. Section 7 started in partial operation in July, but that portion devoted to treatment of oxidized ore was not operated, due to non-delivery of material. Actual milling costs increased 6 per cent over 1917. It may be noticed that the figure $1.37 for milling cost per ton represents an increase of 33 per cent, but the balance represents the amounts reserved for taxes, which were not included in the earlier figures.

At Ray the extraction has shown a gradual increase for several years, which is the gratifying result of a series of minor improvements. The mill now has a capacity of 10,000 tons per day, the tube mill installation in the fine-grinding department having been put in operation in December, and the equipment of the slime plant expanded.

Nevada Consolidated mill recovery shows a decided drop over the record extraction in 1917, due to causes quite similar to those in effect at Chino. The actual tonnage handled should be increased 193,093 tons, this amount being custom ore received from the Consolidated Coppermines Co. This treatment of 11,650 tons daily is an increase of 20 per cent over pre-war years, and a series of minor alterations has now increased the capacity of mine, mill and smelter to about 13,000 tons per day.

The most important construction at the smelter was the installation of a 600-ton coal pulverizing plant for the reverberatory furnaces, replacing the scarce and expensive fuel oil. Four furnaces operated continuously, smelting 654,650 tons of charge, including about 43,000 tons of oxidized ores.

MILLING STATISTICS, PORPHYRY COPPERS, 1918

	Utah	Chino	Ray	Nevada
Tons ore milled	12,160,700	3,836,400	3,411,000	3,999,526
Copper content (per cent.)	1.23	1.63	1.61	1.51
Pounds copper produced	188,092,405	75,655,641	83,599,160	76,607,062
Extraction (per cent.)	65.11	63.3	74.9	67.3
Tons concentrates produced	.....	278,413	.....	.....
Copper content (per cent.)	16.1	14.25	18.2	8.33
Milling cost per ton	$0.93	$1.37	$1.01	$0.93
Total cost copper per pound	16.33c.	17.18c.	17.19c.	17.98c.
Extraction for 1917 (per cent.)	61.1	69.3	74.5	73.1

Consolidated Mining & Smelting Co. of Canada, Ltd.—In the managing director's report for the year ended Sept. 30, 1918, attention is called to the fact that since the beginning of the war the company supplied the Imperial Ministry with the following major metals:

Electrolytic Zinc, 22,356 tons at 12.43c. per lb.
Electrolytic Lead, 39,606 tons at 7.96c. per lb.
Electrolytic Copper, 6,831 tons at 29.68c. per lb.

All of these prices were materially below the average Canadian market price. Metallurgically, the smelting plant at Trail is in very good shape, and with a capacity not so far expanded as to flood the Dominion metal markets. The zinc plant especially has been thoroughly reorganized, and very large reductions made in costs. A new process for the complex ores of the Sullivan mine has been worked out by the research department, which is of the utmost importance, making available huge quantities of developed ore. While all the present plant will be utilized, considerable additions will be necessary to install the process on a 2000-ton scale, but when this is done there should be no trouble in producing zinc and lead at a profit on any market that has existed in recent years, provided the cost of labor and supplies falls with the price of these metals. Recently very material reductions in cost at the lead refinery have been effected, demonstrating that for small tonnage plants the Betts process can compare very favorably with the Parkes process. An arrangement has been made to treat the copper concentrates from the new mill of the Canada Copper Corp., which will involve an increase in the copper refinery from its present capacity of 20 tons per day to a minimum of 50 tons. A small rod mill also will be installed in order that this extra production may be marketed in Canada.

A. I. M. E. Plans Trip to Gary

In conjunction with a large technical program dealing with recent developments in iron and steel metallurgy, a trip to Gary has been planned for the Chicago meeting of the Institute. Arrangements are being made to charter a steamer to convey the members and guests across the south end of Lake Michigan, directly to the steel works. A tour will be made through the various departments of the steel plant, and luncheon will be served at Gary. Technical sessions on subjects in ferrous metallurgy will be held on the boat en route.

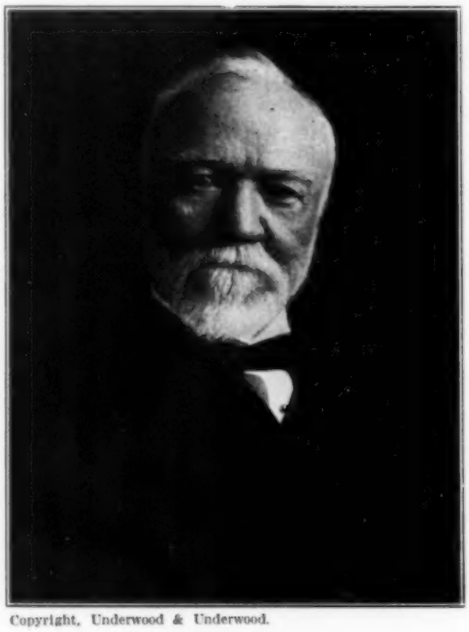
The banquet has been scheduled for the evening of Wednesday, Sept. 24, at the Congress Hotel. By putting this function in the middle of the week it is expected that a maximum attendance can be obtained; members able to come for only a portion of the session can then be present at the banquet, whether they come for the first or latter part of the week.

An elaborate program for the entertainment of the ladies is being prepared, and all members are urged to bring their wives to this meeting.

Andrew Carnegie

ANDREW CARNEGIE died of bronchial pneumonia at Shadow Brook, Lenox, Mass., Aug. 11, at the age of 84. His ancestors for generations back had been weavers. At the time of Andrew's birth, Nov. 25, 1835, his father, William Carnegie, owned a few hand looms. In 1848 the general adoption in Scotland of the steam loom forced William to take his wife and two boys, Andy and Tom, 13 and 6 years old respectively, to America. They made their first home in Barefoot Square, Slabtown, Pa., where the father found employment for himself as weaver and for Andy as a bobbin boy at $1.20 per week wage. The mother sewed for a shoemaker named Phipps. Harry Phipps, the shoemaker's son, was three years younger than Andy. Through lifelong co-operation he and the Carnegie boys were to advance together from poverty to control of the steel industry.

Sixteen years of railroad work developed the big idea from which Mr. Carnegie was to reap his fortune. This was to replace wood construction with iron. On a visit to England in 1868, he learned of the bessemer process and soon had it working in his mills. His success in structural steel manufacture was masterful and he became principal owner of the Homestead and Edgar Thompson Steel Works and other large plants of the firms of Carnegie, Phipps & Co. and Carnegie Bros. & Co. Lake Superior ore and Connellsville coke were incidental developments. In 1899 the Carnegie Steel Co. dominated the steel industry, and in 1901 Mr. Carnegie, after thirty-seven years of activity in the field, retired with a fortune of $460,000,000.



Copyright, Underwood & Underwood.

ANDREW CARNEGIE

Mr. Carnegie's benefactions are in keeping with his wealth and are between 350 and 400 million dollars. Of this amount, 60 million was expended on 2811 free public library buildings; 20 million on colleges; 125 million on the Carnegie Corporation; 30 million on the Carnegie Foundation; 27 million on the Carnegie Institute of Technology; 22 million on the Carnegie Institution of Washington; 4 million on steel workers' pensions, 1½ million on the Engineering Societies Building of New York, etc.

Mr. Carnegie was the author of several books: "An American Four-in-Hand in Britain," 1883; "'Round the World," 1884; "Triumphant Democracy," 1886; "The Gospel of Wealth," 1900; "The Empire of Business," 1902; "The Life of James Watt," 1906; and "Problems of Today," 1909.

In 1888 he married Louise Whitfield. They had one child, Margaret, born in 1897. Miss Carnegie was recently married to Ensign Roswell Miller, U. S. N. The bridegroom was a sophomore in the civil engineering course at Stevens Institute, Hoboken, when war was declared. He planned at the time of the wedding to enter Princeton and complete his studies.

The epitaph to be inscribed on Mr. Carnegie's tombstone at the Sleepy Hollow Cemetery, Tarrytown, N. Y., was written by the steel master and is characteristically descriptive. It reads:

"Here lies a man who knew how to enlist in his service better men than himself."

Associates of Mr. Carnegie have paid elegant tributes to his memory, of which the following are typical:

Chauncey M. Depew—He had a talent beyond any of the constructive manufacturers and merchants, selecting with unerring sagacity the ablest men for the different departments of his industry. Having selected them, he not only gave them great liberties but also large wages according to their success, larger rewards than they could have secured elsewhere. He made many of them phenomenally rich.

Charles M. Schwab—It would be difficult for me to find words to express my love and admiration for Mr. Carnegie. He was my friend, partner and associate for thirty years. He was the greatest man I ever knew and he had a heart so filled with tender sentiment, especially with reference to his associates, as to make him beloved as well as admired by all those who came in business or social contact with him. He possessed the faculty of inspiring others to unusual efforts in a greater measure than any man I ever knew, and he always won by expressions of appreciation rather than criticism. The world has lost a great man and a great benefactor to humanity, and I have lost a greater friend than whom no man ever had.

George W. Perkins, chairman of the finance committee of the Carnegie Foundation — I am deeply grieved to hear of Mr. Carnegie's death. He was a very great American, belonging to that class which after the Civil War was quick to appreciate that we had a united country and a great opportunity. He grasped the new machinery which inventors placed in our hands at that time, and with them threw all his great mental energy into developing our country. When his active business career closed, with the same energy he gave a large percentage of his wealth to movements that he believed would help the people. One of the last talks I had with him was about profit-sharing. He was most enthusiastic in his commendation of the Steel Corporation's profit-sharing plans, and expressed the belief that the principle of profit-sharing was destined to be a great factor in solving the problems between capital and labor.

James B. Clews—The death of Mr. Carnegie removes one of the greatest characters the world has ever known. In these days of labor unrest his career offers a fitting example of what can be accomplished by one commencing in the lowest station of life, when he possesses the necessary qualifications for rising in life and makes the most of his opportunities.

Carnegie was born a weaver, but he threaded together a tapestry of men instead of gilt and fiber.

Army Reorganization Bill Discards Chemical Warfare Service

THE Army reorganization bill, as submitted to Congress, threatens the undermining of most of the technical development of the Army and does not even mention the highly technical Chemical Warfare Service. In a letter accompanying the bill, the Secretary of War suggests that the Chemical Warfare Service can be handled by the Engineer Corps. It is so apparent that this service is so entirely distinct from the work done by the Engineer Corps that chemists are aroused at what they believe to be unreasonable prejudice on the part of the professional element of the Army against a service which they feel contributed the most striking chapter to the record of the war. The General Staff's conception apparently is that a technical man is not fit to be an officer, or at least they intend to make a jack-of-all-trades of him.

Before officers can specialize on gas or any other technical development they must run the gamut of examinations and become thoroughly versed in all matters pertaining to the line of the Army. To make it still harder for the specialist, the bill provides that an officer may serve no more than four years out of any six in one line of duty.

Gen. March Against the Service

Congress has approved the Chemical Warfare Service to the extent of providing money for its continuance until June 30, 1920, but Gen. March has come out flatly against the service, although he does grant that research in gas should be continued. On the other hand, chemists point out that gas was used in the World War to a comparatively small extent. This was due partly to the lack of ingenuity and initiative on the part of the Germans and also to their lack of raw materials. When the war ended, however, such progress had been made by the Allied Governments as to make possible a fair idea of what might be expected in the use of gas in future wars.

It has developed since the armistice that Germany was so afraid of the possibilities of gas that she herself initiated a propaganda in December, 1917, looking to its being barred during the remainder of the war. In March, 1918, having learned that the Allies were making remarkable strides in gas production, Germany appealed openly for the suspension of gas warfare. That was after Germany learned that the United States alone was actually producing four times as much mustard gas as she herself could produce. As a matter of fact, ninety days after the armistice the United States would have been producing twenty times as much mustard gas as were the Germans, while our production of phosgene and lachrymatory gases were outstripping the German production in almost the same proportion.

Opposition to Gas Warfare Diminishing

As gas warfare is better understood, the opposition to it is diminishing. Out of all gas casualties among the Allied armies, the death rate was less than 3 per cent. The death rate among casualties resulting from bullets and high explosives often runs as high as 25 per cent. That the Germans were greatly aided by their gas warfare, despite their clumsy use of a weapon that might have been wielded far more effectively, is shown by the fact that gas was responsible for three out of each ten casualties that they caused. An analysis of gas casualties shows that very few of those injured were permanently disabled. There is concrete evidence that it is the most humane way of putting a man out of combat.

Study of chemical warfare leads to prediction by responsible persons that in a possible future war gas will cause 50 per cent or more of all casualties, but by certain changes in gases which even now are being developed the death rate will be cut to one-tenth of that among the casualties caused by high explosives. It is believed that the future will see any battlefield saturated with gas all the time, which will make necessary the continuous use of masks by all within the area.

The highly technical skill necessary in the carrying out of chemical warfare, as well as the need for immense industrial resources, gives the more highly civilized nations a weapon of tremendous efficiency. By the use of lachrymatory or similar gases, it might be possible to dominate a situation entirely without causing loss of life.

The basis of two-thirds of gases used in warfare is in coal-tar derivatives. Most of the remainder are chlorine compounds. An exception is the lachrymatory gas, which has a bromine base. Thus the United States is in an enviable position by having unlimited quantities of the needed raw materials and it is argued that it would be to the nation's advantage to have recourse to chemical warfare in case war became necessary.

The Microscope in War

Captain Howard I. Cole of the laboratory of Arthur D. Little, Inc., at Cambridge, Mass., told lately of the use of the microscope in war. Few persons are aware how large a part this instrument has come to play in chemical analysis, more particularly in the identification of materials.

The most important work was the analysis of defective explosives, primers and other munitions of the Allies, as well as the materials found in captured German shells and duds. By the micrometric measurement of powder grains, etc., it was often possible to report the efficiency of explosives, which is largely dependent upon the size of the particles.

A pocket case 8 in. long will carry as many as 60 little reagent tubes for microscopic work and, as can be readily understood, the chemist can operate with much smaller amounts of material with the microscope than he can without it. Indeed, if the problem has to do, for instance, with the nature of an enemy primer, the very small amount of material under the primer cap usually restricts analysis to this instrument.

Many bodies are determined by their crystalline forms, and both solids and liquids are often recognized by their refractive indices. Many poisons are identified by the same method. There are almost always a considerable number of suicides in battle, some from shooting and others from poisoning. The presence of the suspected poison in the stomach indicates the latter.

Many alloys are examined to discover their content, and the same may be said of fuses. Clothing of all sorts, balloon fabrics, paper cloth, captured sand bags and paper tape for carrying shells were examined to arrive at a sense of conditions in Germany. Food was under constant test to find out whether it had gone bad or not, or was adulterated.

The increased use of the microscope in progressive laboratories as compared with twenty years ago would surely surprise many an old timer.

British Government Aids Dye Trade

The British Board of Trade has set up a central importing agency which will be the sole medium through which dyestuffs can be imported into the United Kingdom. This agency will furthermore buy dyestuffs abroad on a commission of 1 per cent. The American Chamber of Commerce in London reviews the situation as follows:

On Feb. 24, 1919, the importation of all dyestuffs was prohibited except under license. At the same time the government, in accordance with its scheme for assisting the dye-making industry, set up a special Trade and Licensing Committee at Manchester in order to determine the kinds and quantities to be imported and to deal with all importing questions. To get immediate supplies with which to carry on, a general license was issued for all dyestuffs of bona fide American, French or Swiss origin, but this was withdrawn on April 9. Further, to regulate the import of dyestuffs and particularly to prevent the dumping of German materials on the British market, there has now been set up under the direct control of the Trade and Licensing Committee this Central Importing Agency through which all imports of dyestuffs must pass at some stage. This will include imports of German dyestuffs when such trade is allowed by the withdrawal of the trading with the enemy regulations.

Except in the case of German dyes, this Central Importing Agency will now undertake if desired the purchase of dyestuffs abroad on behalf of British consumers. Where it is desired, however, to make purchase direct or through recognized merchants, the goods will merely require to be consigned to the agency for the account of the particular consignee.

The Agency will charge a commission of 1 per cent on the invoice value of the goods for its buying services.

American Institute of Mining and Metallurgical Engineers

Mr. Charles M. Schwab will be a speaker at the banquet of the American Institute of Mining & Metallurgical Engineers to be held in Chicago Sept. 22 to 26 inclusive. Elaborate plans for both the technical and social side of the meeting have been perfected. Engineers who make the trip to Chicago for this meeting are assured of one of the most interesting annual meetings which the Institute has held. In addition to about one hundred and fifty papers which have been prepared for the meeting, trips to the zinc smelting districts, the steel works at Gary and the refineries at Whiting and East Chicago are included. A boat trip on the lake and numerous social events have been arranged for the ladies. The Fifth Annual Exposition of the Chemical Industries will be held in Chicago at the same time and members of the Institute are cordially invited to attend the exposition and become better acquainted with the allied industries.

Importations of German Potash Allowed

Besieged by the farmers on the one hand and the producers on the other, the War Trade Board section of the State Department had a busy time for a month prior to Aug. 7, when it finally decided to throw down the bars and allow the entrance of German potash. The producers now have placed their hope in Congress, and expect to obtain relief in the form of a tariff.

Sewage Disposal Committee

The Division of Chemistry and Chemical Technology of the National Research Council has formed a committee on sewage disposal composed of the following members: Prof. G. C. Whipple, of the Department of Sanitary Engineering, Harvard University, chairman; Major C. G. Hyde, professor of sanitary engineering, University of California; Lt.-Col. Edward Barton, professor of sanitary chemistry, University of Illinois; Lt.-Col. W. D. Bancroft; Prof. E. B. Phelps; Dr. W. W. Garner, physiologist, Bureau of Plant Industry, Department of Agriculture.

The committee will undertake the following projects:

1. To prepare a research survey of the field, with special reference to possible methods of sewage disposal which will recover the valuable oils, fats and fertilizer constituents of the sewage; this survey to include statistical data and a discussion of the economic aspects of the subject as well as the scientific ones.
2. To outline a series of basic research problems necessary to the further extension of our knowledge of the possibilities of recovering and utilizing the valuable constituents of sewage.
3. To ascertain what researches are already in progress in the country in connection with this problem and, if it seems desirable, to prepare a list of sewage experiment stations or similar organizations whose equipment and staffs may possibly be utilized in connection with any project of co-operative research which it seems wise to undertake.
4. To prepare general plans and estimates of cost of establishing a sewage experiment station to study new methods of treating sewage for the recovery of its valuable constituents and to work in close co-operation with investigators now engaged or who in the future may be interested in undertaking physical, chemical or biochemical investigations on various aspects of the problems which present themselves.
5. To investigate particularly the Rice process and the Miles process of sewage treatment and to make recommendations to the Division as to what action, if any, the Council might take with reference to research or development in connection with one or both of these processes.

British and American Dye and Chemical Traders to Send Commission Into Germany

The Dye and Chemical Trade Group of the American Chamber of Commerce in London is about to send a mission into Germany and Austria to study the commercial situation there as related to the dye and chemical industry. Present problems and future prospects will be studied, particularly with reference to import and export possibilities, methods of payment, necessary precautionary measures, etc. Both importers from America and British distributing merchants will be represented on this mission, and the information obtained will be put at the disposal of the industries in both countries. The State Department at Washington has been asked to give official recognition to the American delegates on this commission to enable them to proceed where they wish in Germany and Austria, and to accomplish the objects of their mission.

World's Gold Production

The production of gold has been steadily decreasing since 1915, when the highest point was reached. In that year the world's production of gold was $468,724,918, of which the United States produced $101,035,700, South Africa about $188,000,000 and Australia about $50,000,000. In 1918 the world's production was $377,300,000, of which the United States produced $68,493,500, South Africa $176,000,000 and Australia $26,700,000.

Experimental-Retort Tests of Orient Coal*

Description of Experimental Work for Coking Illinois Coal—Investigation on the Influence of Coking Temperature Upon the Quantity and Quality of Coke Produced—Comparison With Results Obtained When Using Other Coals

By R. S. McBride† and I. V. Brumbaugh‡

THE Bureau of Standards, in connection with two special coke-oven tests, found it desirable to investigate the influence of temperature of coking upon the quality of the coke produced and upon the quantity and quality of gas made from the coal[1]. Although several very similar coals were used in the oven tests, the experimental-retort work was limited to coal obtained from the Orient mine of the Chicago, Wilmington & Franklin Coal Co., located at Orient, in the south central part of Franklin County, Illinois. The data obtained from the coking tests with this coal at various temperatures are of such general interest that they are presented here.

A series of five experimental-retort tests was made at various temperatures. The coking was done in a cylindrical retort of cast iron, set up as shown in Fig. 1. This apparatus was made available to the Bureau through the courtesy of the Bethlehem Steel Co., Sparrows Point, Md., which has used this equipment regularly for trying out coals or mixtures of coals intended for its by-product coke ovens. Data of a few similar retort tests on a variety of other coals which have been tested at this plant are presented for comparison.

Apparatus and Method Used

The cylindrical retort, shown in Fig. 1, was enclosed in a refractory-brick setting approximately 3 ft. in each dimension. It was heated by a large bunsen-type burner, using coke-oven gas. The sample of coal to be tested was pulverized and dried thoroughly, generally by allowing it to remain over night in an oven at approximately 100 deg. before introduction into the small cast-iron box used to hold the charge. The retort was heated up to a temperature from 60 to 100 deg. C. above the temperature desired for the test in order to allow for the unavoidable rapid cooling that takes place when the lid of the retort is opened for introduction of the charge. Immediately after each charge was placed in the retort an oil soaked rag was thrown in. This rag quickly took fire and exhausted the oxygen in the retort space, thus eliminating the possibility of an explosion as the gases from the coal were generated.

The temperature of the retort was maintained at the desired point according to the indications of thermocouple T_1, the location of which is clearly shown in Fig. 1. Thermocouple T_2 furnished auxiliary temperature readings, but these were not used as the basis for temperature control. After introduction of the charge the lid was quickly closed and mudded up to prevent gas leakage. The gas driven off from the coal was discharged from the retort through the outlet pipe shown in the figure. As soon as the gas from the coal began to appear at a purge cock in this line, this purge cock was closed and the gas allowed to flow into a small storage holder in which the entire volume generated from the charge was collected. During the test period record was taken at intervals of 5 min., showing temperatures of T_1, T_2, the volume of the gas collected in the holder, and the temperature of this gas. When the charge ceased gassing the coke was removed and quenched, and a record made of the barometric pressure and of the temperature and volume of the gas in the holder.

After quenching, the coke was examined thoroughly, a description recorded, and an average sample prepared for analysis. The gas collected in the storage holder was analyzed, the candlepower and specific gravity determined, and the heating value calculated from the analysis. From these data were calculated the B.t.u. in the gas per lb. of coal carbonized, the cubic feet of gas per lb. of coal, and the candle-feet per pound.

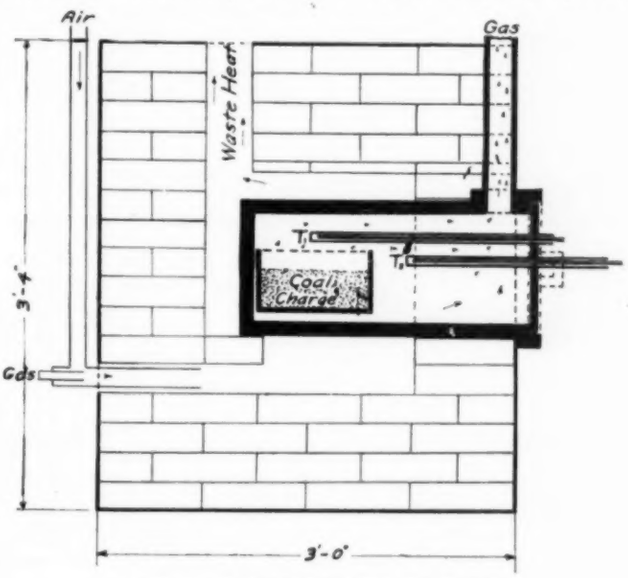


FIG. 1. EXPERIMENTAL RETORT

Arranged for heating by bunsen burner, using coal gas. Inside dimensions of retort: 9½ in. in diameter, 24 in. long; metal 1 in. thick. Inside dimensions of coal box: 9½ in. long, 4⅝ in. wide, 5 in. deep; metal ¼ in. thick. Space between outside of retort and masonry, 2½ in. Location of thermocouples: T_1, 5⅝ in. from rear and 2 in. from top of retort; T_2, 14 in. from rear and 4 in. from top of retort.

Coal Used

The coal used for four of these tests was that remaining from the sample taken at St. Paul, Minn., when the Bureau tested the coke plant of the Minnesota By-Product Coke Co., using Orient, Ill., coal[2]. For the fifth test there was another smaller sample remaining from

*Published by permission of the Director, Bureau of Standards. This is an advance publication of work reported in Technologic Paper 134 of this Bureau.

†Engineer Chemist, Bureau of Standards.

‡Assistant Gas Engineer, Bureau of Standards.

[1]"The Coking of Illinois Coal in Koppers Type Ovens," by R. S. McBride and W. A. Selvig, Chemical & Metallurgical Engineering, Vol. 21, No. 3, Aug. 1, 1919, p. 122.

[2]*Loc. cit.*

another shipment of Oregon coal used by the Bureau in a separate coke-oven test at Dover, Ohio. Table I gives the analysis of these coal samples as used in the retort tests. These analyses agree very closely with those of the carefully prepared samples analyzed by the Bureau of Mines in connection with the plant tests mentioned above. The results of these tests, therefore, can be regarded as typical of the results for the larger shipment. Table II shows the size of the coal as crushed for the retort test.

Results Obtained

The results of the five retort tests are given in Table III. In considering these data it must be borne in mind that only a very limited number of tests could be made because of the small samples and the short time available for the work. One should be very careful, therefore, not to try to draw too many conclusions from these results.

TABLE I—ANALYSIS OF ORIENT COAL AS USED IN EXPERIMENTAL-RETORT TESTS (DRY BASIS)

	Sample from	
	St. Paul, Minn.	Dover, Ohio
Volatile matter	37.8%	38.0%
Fixed carbon	52.3%	53.4%
Ash	9.9%	8.6%
Sulphur	0.87%	1.47%
Phosphorus	0.007%	0.002%
Total carbon	73.0%	76.3%
Hydrogen	5.1%	5.3%
Oxygen	9.9%	8.5%
Ratio: Hydrogen-oxygen	51.6%	62.6%
B.t.u. per lb. (dry)	12,800	13,000
B.t.u. per lb. (dry and ash-free)	14,200	14,200

TABLE II—SIZES OF CRUSHED COAL AS USED IN EXPERIMENTAL-RETORT TEST

Mesh	Percentage Through Sieve
8	99.7
10	89.5
20	50.8
30	36.7
40	30.3
60	19.3
80	13.3
100	11.0

Test No. 1 was made as nearly as possible to duplicate the usual temperature conditions of testing followed by the Bethlehem Steel Co., so that a basis for comparison of this coal with others would be available. In this particular test the gas for heating the retort was cut off completely 40 min. after the introduction of the charge. The data from this test are the only ones which can be compared with the results given in Table IV for other coals. The coke from this sample was fairly good, and the charge was thoroughly coked, showing considerable contraction in the sample box. The pieces were the medium size with no evidence of sponge and only a small amount of fine pebbly material on top of the coke. The coke had very small and regular cell structure, but was soft, shattering rather easily, with a tendency for longitudinal fracture, but no distant cross-fracture. It was light in weight and of a dark silver color.

Test No. 2 was made at as nearly as possible constant vapor temperature (T_1) of 775 deg. C. This was approximately the average temperature of the vapor above the coal as recorded in the test of the coke plant of the Minnesota By-Product Coke Co., St. Paul, Minn., when the coking time was approximately 19 hr., but it is probable that for the same temperature of retort as of oven the vapor temperature in the retort would be higher than the corresponding vapor temperature in the oven. The coke results obtained in this case should probably, therefore, be more nearly comparable with the results of special oven tests made at St. Paul when coking time was approximately 25 hr. The coke from this test was fair, contracted in the box and broke up into large

TABLE III—EXPERIMENTAL-RETORT TESTS OF ORIENT COAL

Test number	1	2	4	3	5
Date	Jan. 14, 1919	Jan. 15, 1919	Jan. 17, 1919	Jan. 16, 1919	Jan. 18, 1919
Temperature average T_1 (deg. C.)	840	775	700	600	605
Weight of dry coal (lb.)	4.48	4.00	4.00	4.00	3.20
Gas generated (cu.ft. at 30 in. 60 deg. F.)	26.3	18.5	13.6	8.5	7.8
Gas per lb. of dry coal (cu.ft.)	5.87	4.62	3.40	2.12	2.44
Gas per net ton of dry coal (cu.ft.)	11,750	9250	6800	4250	4850
Candlepower of gas	5.4	10.0	12.2	15.7	15.9
Candle-feet of gas per lb. of dry coal	31.7	46.2	41.5	33.3	38.8
Specific gravity of gas	0.465	0.510	0.625	0.660	0.655
Analysis of gas: CO_2	4.7	5.1	8.2	7.2	8.2
O_2	1.0	1.3	1.0	0.8	1.6
Ill	2.2	3.1	3.8	5.0	5.2
CO	17.3	13.6	11.3	8.1	8.3
CH_4	25.1	30.6	36.6	37.1	39.5
H_2	46.3	44.7	33.6	30.3	26.0
N_2	3.4	1.6	5.5	11.5	11.2
Heating value, calc. from analysis (B.t.u.)	510	570	600	610	625
B.t.u. in gas per lb. of dry coal	3000	2630	2040	1300	1520
Coke formed: Large (lb.) dry	2.99	2.66	2.79	2.72	2.19
Loose material (lb.) dry	0.04	0.06	0.17	0.21	0.19
Total (lb.) dry	3.03	2.72	2.96	2.93	2.38
Coke yield: Large (per cent of dry coal)	67.0	66.5	70.0	68.0	68.5
Loose material (per cent of dry coal)	1.0	1.5	4.0	5.0	6.0
Total (per cent of dry coal)	68.0	68.0	74.0	73.0	74.5
Coke analysis (dry basis):					
Volatile	5.3	7.1	7.1	11.5	14.0
Fixed carbon	80.2	79.1	.....	.....	74.2
Ash	14.5	13.8	.....	.....	11.8
Sulphur	0.78	0.78	.....	.....	1.23
Phosphorus	0.014	0.014	.....	.....	0.004

pieces with no sponge and only a small amount of fine material for about ½ in. on the upper surface of the mass. It had small and slightly irregular cell structure; but as a whole the coke was clean, soft, and somewhat tougher than in test No. 1, with longitudinal fracture but no cross-fracture. It was slightly heavier than the material from test No. 1 and of dark color.

Test No. 3 was made with the idea of obtaining results at a somewhat lower vapor temperature above the coal than the average prevailing in the St. Paul test, but higher than noted in the other tests made by the Bureau at Dover, Ohio, where the vapor temperature above the coal averaged about 550 deg. C. It was attempted to maintain an average throughout for T_1 of 600 deg. C., and the results correspond very closely to this temperature. Judged by the results of this test, the coal would normally be characterized as only semi-coking at this temperature, for the coke was very poor. There was some contraction in the box and no sponge formed, but there was a very large amount of loose material, that appeared almost uncoked, on top of the larger pieces of coke. The cell structure was small and very irregular. Because there was a very poor cementing action, even the large pieces were soft and easily broken in the hand. The material was fairly heavy, with decided longitudinal fracture and no marked cross-fracture. The color was very dark.

For Test No. 4, in view of the very poor results judged by the character of the coke obtained in test No. 3, it was decided to conduct the test at a somewhat higher temperature. The effort was to maintain T_1 constant at 700 deg. C. throughout this test. Even at this temperature the coal would be characterized as semi-coking, although the coke was superior to that in

TABLE IV—EXPERIMENTAL RETORT TESTS OF OTHER COALS

Data Furnished to Bureau of Standards by the Bethlehem Steel Co. All Tests 4.48 lb. at Approximate T_1 Average of 850 deg C.

Date	May 11, 1918	Sept. 18, 1918	May 16, 1918	May 10, 1918	May 10, 1917	Dec. 6, 1917	May 8, 1917	Feb. 11, 1917
Coal	40% Washington 60% Quemahoning	50% Gauley 50% Pocahontas	Washington	Quemahoning	Morrell, Fayette County, Pa.	Logan County, W. Va.	Mt. Pleasant, Fayette County, Pa.	Tip Top, Fayette County, Pa.
Coal Analysis: Volatile	25.42	28.85	33.02	17.23	31.20	26.08	31.55	30.63
Fixed Carbon	66.58	63.98	58.51	75.45	57.80	45.95	59.86	59.07
Ash	8.00	7.17	8.47	7.32	11.00	27.97	8.59	10.30
Total Carbon	79.63	79.69	77.78	83.15	72.26	59.77	72.45	70.71
Hydrogen	4.72	4.85	5.05	4.48	4.30	3.82	4.41	4.16
Oxygen	6.35	7.05	7.40	3.75	11.01	7.14	13.25	13.63
Ratio: H/O	74.33	68.79	68.24	119.46	39.05	53.50	33.27	30.52
Gas per lb. of coal (cu.ft.)	4.50	4.55	5.10	4.50	5.17	3.49	5.02	4.08
Gas per net ton of coal (cu.ft.)	9,000	9,100	10,200	9,000	10,340	6,980	10,040	8,160
Candlepower of gas	8.0	6.2	8.5	3.7	1.2	10.6	2.6	2.3
Candle-feet of gas per lb.	36.0	28.2	43.3	16.7	6.2	37.0	13.1	9.4
Specific gravity of gas	0.400	0.476	0.440	0.424	0.450	0.466	0.495	0.551
Analysis of gas: CO_2	3.1	4.5	4.1	2.3	5.6	4.4	8.0	10.8
O_2	0.9	0.5	0.7	0.8	0.6	0.6	0.4	0.7
Ill.	2.5	2.0	2.6	1.6	1.4	3.1	1.9	1.6
CO	10.4	12.6	11.7	9.9	15.6	8.6	15.5	14.6
CH_4	29.3	31.5	30.8	27.0	21.5	35.0	24.0	26.5
H_2	52.8	46.8	47.5	57.0	51.1	46.1	48.4	42.7
N_2	1.0	2.1	2.6	1.4	4.2	2.2	1.8	3.1
Heating value calc. from analysis (B.t.u.)	557	556	561	526	465	600	492	490
B.t.u. in gas per lb. of coal	2510	2530	2860	2370	2410	2090	2470	2000
Coke obtained	Extra good* Shatter Test 80%	Good* Shatter Test 66%	Fair* Fingery Sponge Shatter Test 52%	Good	Semi-Coking Coal	Semi-Coking Coal	Non-Coking Coal	Non-Coking Coal

* These results refer to coke from full-size oven tests.

test No. 3. It showed contraction in the sample box, large pieces, and no sponge; but there was a large amount of loose and apparently uncoked material on top of the coke. The small and somewhat irregular cell structure, with soft friable material resulting from a poor bond, corresponds to what would be expected from the results of previous tests. The material was fairly heavy, with typical longitudinal fracture and no cross-fracture, indicating that at this temperature there was a decided tendency to secure blocky coke rather than that of a fingery shape. As in the previous test the material was very dark in color.

Test No. 5 was run with a small sample of coal remaining from the Dover test, in an effort to duplicate the conditions of test No. 3, namely an average for T_1 of 600 deg. Although this coal came from an entirely different shipment from that used at St. Paul, the results were almost exactly the same as from the test No. 3, made at the same temperature.

By comparison of the results for the five tests, the very large influence of temperature of coking upon the quantity and quality of gas is evident. In Fig. 2 is shown graphically the change in quantity of gas per lb. of coal carbonized with changing temperature. In this connection it should be noted that the higher temperature results represent not only a more complete elimination of the volatile material from the coal, but also a decomposition of the heavier volatile material into the gaseous constituents. Naturally, as the vapors leaving the coal are subjected to this greater decomposition at higher temperature, the average heating value of the

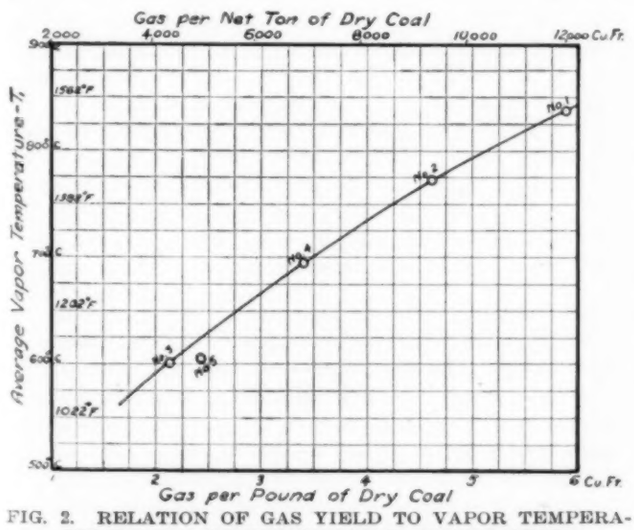


FIG. 2. RELATION OF GAS YIELD TO VAPOR TEMPERATURE T_1 FROM EXPERIMENTAL RETORT TESTS
Test number is indicated beside each result plotted

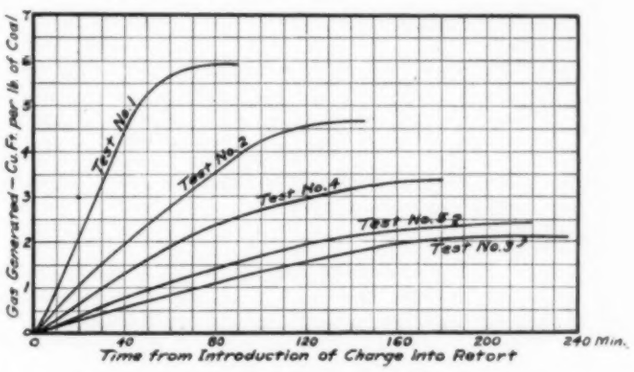


FIG. 3. GAS GENERATED IN EXPERIMENTAL RETORT TESTS

gas is diminished. This diminution of heating value per cu.ft. is, however, by no means enough to offset the effect of the larger volume, as is shown by the fact that the B.t.u. in the gas per lb. of coal carbonized at 840 deg. is almost double that at 600 deg.

Fig. 3 shows the influence of temperature upon the rate at which the gas is generated and, of course, also the influence of temperature upon the time required for complete gasification of the charge.

Influence of Temperature Upon Character of Coke Produced

As would be expected, the amount of volatile matter left in the coke decreases as the temperature of coking increases; and correspondingly with more volatile matter in the coke the yield of coke is higher. However, at the lower temperature the percentage of fine material

is much greater and the quality of coke very much inferior. In this connection, however, it should be noted that in none of the coking tests was it practicable to secure temperatures as high as are frequently used in oven practice with coals that are regarded as specially suited to the production of metallurgical coke. If such higher temperatures had been used another influence noted in connection with the St. Paul test would probably have appeared, namely, that at the high temperatures there is great tendency for the coke to be brittle, fingery and small, instead of fairly tough and blocky.

As pointed out above, great care should be exercised in drawing the conclusions from these few tests. However these few conclusions are strong confirmation of the results of the special oven tests made at St. Paul and are, therefore, a very valuable bit of supplementary data, which it is hoped will be of interest to the by-product coke-oven operators in general, but most especially to the operators who use Mid-Continent coals.

Similar Results on Other Coals

For sake of comparison there are included in Table IV data for other coals similar to the data given in Table III for the Bureau's tests of Orient coal. A general comparison of these data is interesting, but no detailed conclusions should be drawn, as comparison of such single tests is apt to be misleading.

Washington, D. C.

Prices of Chemicals During the War

By Frederick E. Breithut
Chairman, Chemicals Section, Price Section, War Industries Board

UNDER the direction of Dr. Wesley C. Mitchell, the Price Section of the War Industries Board has made an investigation of prices during the war. The results of this series of studies are embodied in some fifty-seven bulletins which are now in press. The aim of all these studies is to make the price quotations gathered by various Government agencies available to men concerned with problems of business readjustment, and also to provide a permanent record of the great revolution in prices that accompanied the World War.

The commodities selected for price study have been placed in five large groups as follows:

Food
Clothing
Metals
Building Materials
Chemicals

Each of these groups has been further subdivided into classes of commodities industrially or chemically related, and a separate bulletin has been prepared for each class. The commodities placed in the chemicals group have been discussed in fourteen such bulletins issued under the following titles:

Numbeer[1]	Subject	Author
1 (53)	Coal Tar Crudes, Intermediates and Dyes	W. N. Jones and F. W. Cassebeer
2 (54)	Drugs and Pharmaceuticals	W. Lee Lewis and F. W. Cassebeer
3 (50)	Essential Oils, Flavoring and Perfumery Materials	W. B. Meldrum
4 (56)	Explosives	C. L. Fry
5 (48)	Fertilizers	H. L. Trumbull
6 (46)	Heavy Chemicals	H. L. Lewenberg
7 (45)	Mineral Acids	H. L. Lewenberg
8 (47)	Miscellaneous Inorganic Chemicals	W. B. Meldrum
9 (57)	Miscellaneous Organic Chemicals	Arthur Minnick
10 (52)	Natural Dyestuffs and Tanning Chemicals	P. W. Carleton
11 (44)	Paints and Varnishes	Arthur Minnick
12 (55)	Proprietary Preparations	W. Lee Lewis and F. W. Cassebeer
13 (49)	Soaps and Glycerine	H. L. Trumbull
14 (51)	Wood Distillation Products and Naval Stores	P. W. Carleton

To throw as much light as possible upon the course of price fluctuations, each bulletin includes a brief résumé of conditions prevailing in the industry of which it treats, and discussion of data regarding production, imports, exports, stocks, Government purchases and Government control. Special emphasis has been placed upon the factors factors influencing the markets and causing marked variations in prices.

Price Charts to Show Movement Away From Pre-War Level

All the bulletins contain graphic representations of the price fluctuations of commodities. These price charts are primarily designed to show the movement of prices away from the pre-war level. They are drawn on a uniform scale and hence are strictly comparable with one another. The average actual prices in the 12 months preceding the outbreak of the war, July, 1913, to June, 1914, inclusive, have been taken as equal to 100, and the actual prices in the whole 72 months

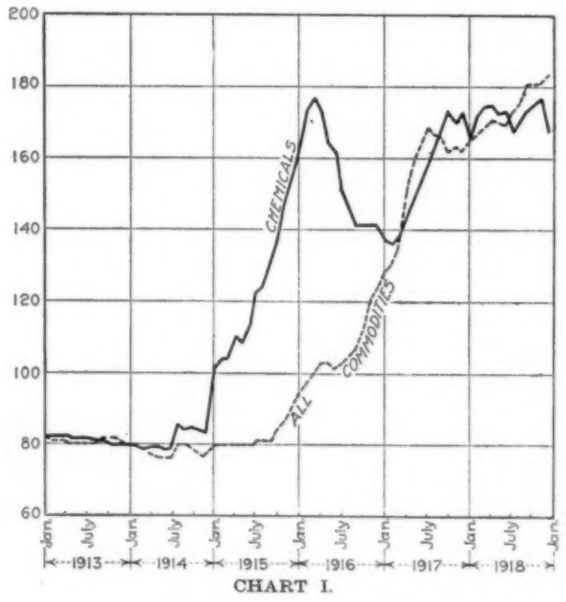


CHART I.

from January, 1913, to December, 1918, inclusive, have been converted into relative prices on this basis. If, for example, the selling price of bromine averaged 30c. per lb. during the 12 months preceding the outbreak of the war, and if it rose to 40c. per lb. in December, 1914, the relative price in that month would be 133; if the price rose to 75c. per lb. in September, 1918, the relative price for the latter month would be 250.

For the benefit of those who wish to gain some idea of the general trend of prices in an industry in addition

[1] The serial number of each bulletin is given in parentheses.

to the fluctuations in prices of particular commodities, "index numbers" have been calculated. The simple average of the prices of the commodities sold—some by the gram, some by the ton, some by the gallon and some by the liter—would obviously have little value. Therefore, in making index numbers each commodity has been "weighted" by multiplying the monthly prices from 1913 to 1918 by the amount of the commodity produced in 1917, combined with the imports of the commodity during the calendar year 1917. That year was selected as the weighting year because the tables are intended to reflect war-time conditions, and because production data for 1918 were not obtainable for many commodities when the bulletins were being written.

How "Index Numbers" Were Obtained

An enumeration of the successive steps in making these index numbers will show more clearly the significance of the figures. First, for every commodity included in the computation there was made an estimate of the total quantity produced in the United States in 1917, and to this amount the amount imported in the calendar year 1917 was added. The sum represented the "commodity weight." Second, the commodity weight was multiplied by the price of the commodity in each month of the six-year period covered. The product in each case was the "weighted price" for the month. Third, the weighted prices for all the commodities in the class dealt with were added up for each month. This gave the "monthly aggregates" for the class. Fourth, the average monthly aggregate for the 12 months ended June, 1914, was computed. Finally, the average monthly aggregate for the 12 months ended June, 1914, was made equal to 100, and the monthly aggregates for the 72 months changed into relatives on this basis. The results are the index numbers of the class.

The index numbers derived in this way for an industry are strictly comparable with the relative prices for particular commodities. By making use of them one can get a clear idea of average price fluctuations in a given branch of business and can compare fluctuation in one industry with those in others.

In addition to the 50 bulletins devoted to separate classes, the series of price studies includes group bulletins on the prices of foods, metals, clothing, building materials and chemicals. There is also a set of international comparisons of price fluctuations, a special record of Government control over prices during the war, and, finally, a general summary of the whole inquiry, in which the methods employed are set forth more fully and in which the leading results from all the bulletins are drawn together for comparison.

It is the purpose of this paper to summarize the results shown by the 14 class bulletins and the group bulletins dealing with chemicals. To this end two charts have been prepared.

Chemicals Compared With All Commodities

Chart I shows the index numbers of chemicals as compared with "all commodities." Comparative features of the two curves are so outstanding that they call for little comment. The "all commodities" curve does not begin its rise until the middle of 1915 and except for a slight depression in the middle of 1916 continues its steady upward course to the neighborhood of 200. The curve for chemicals, on the other hand, begins its rise in the middle of 1914, showing immediate response to the outbreak of the war in Europe. The steep rise in price mounts until reaches almost 200 in the spring of 1916. By this time the United States and the Allies had got into large-scale production, and as a consequence there is a depression, which lasts until the beginning of 1917. The entrance of the United States into the war is immediately followed by a sharp

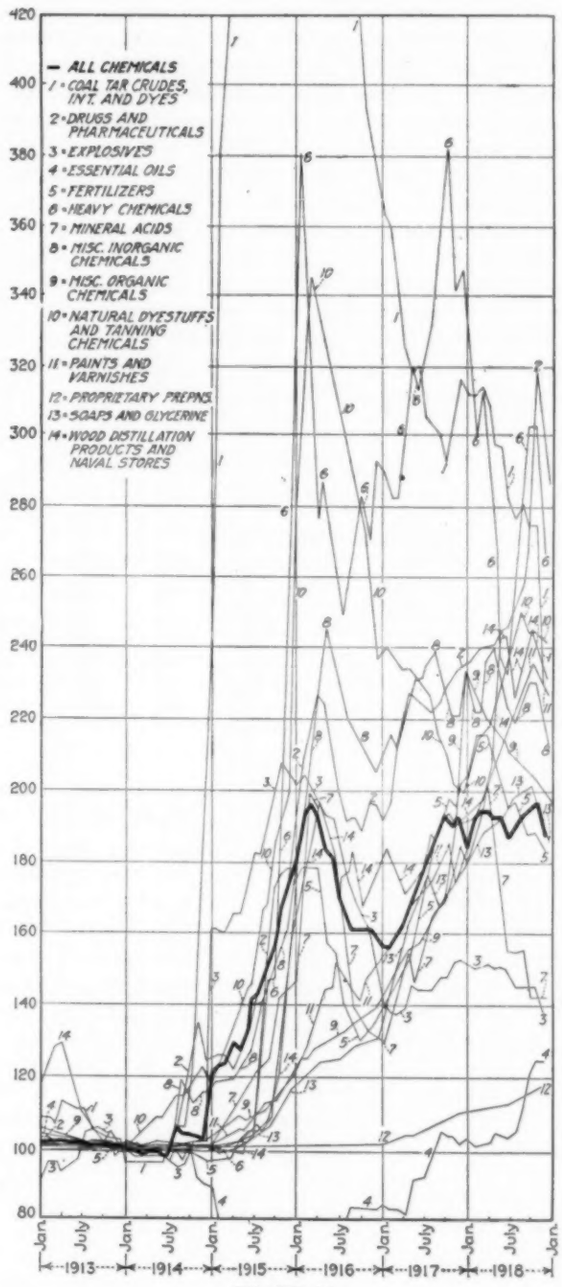


CHART II.

rise in prices of chemicals until the old high level of about 190 is reached. The signing of the armistice finds the price of chemicals hovering in this region. With the signing of the armistice, however, there is a marked contrast between the behavior of the prices of "all commodities" and the behavior of the prices of chemicals. The upward trend of the prices of "all commodities" continues, but the prices of chemicals show instant depression. The tremendous stocks of chemicals on hand and the new facilities and equipment

for production—far beyond our needs in normal times—cause this drop.

Price Fluctuations of Chemicals

Chart II presents an analysis of the curve representing the price fluctuations of chemicals. The thin lines represent the index numbers of the 14 classes of chemicals. The heavy line represents the "weighted" index numbers of all chemicals. If we look upon the pre-war base as an elastic band, seeking its normal place at the 100 line, and imagine the play of economic forces as pushing and pulling this band above or below the pre-war level, we have a vivid picture of what actually took place. If we add to this interpretation that the effects of these pushings and pullings on the elastic band shall be proportionate to the "weights" of the industries as represented by the volume of business, we then have a full picture of what this chart attempts to show.

It will be observed that the index numbers of class 1 (coal tar crudes, intermediates and dyes) showed such extreme variation during the period April, 1915, to September, 1916, that they cannot be represented on the scale as drawn in the chart. Therefore the actual figures for this class are given in Table I.

TABLE I—COAL TAR CRUDES, INTERMEDIATES AND DYES

Index Numbers by Months, 1913-1918
Base, Average Price July, 1913, to June, 1914—100

	1913	1914	1915	1916	1917	1918
January	109	95	242	747	364	312
February	109	95	383	732	359	311
March	108	95	417	724	345	314
April	113	95	581	649	325	308
May	112	95	473	649	318	297
June	111	95	596	591	320	297
July	111	103	679	532	305	281
August	106	107	688	478	302	278
September	105	187	697	405	300	280
October	103	215	735	392	293	274
November	103	252	737	376	307	275
December	102	222	758	371	316	229

It is difficult to avoid entering into a detailed discussion of each of the classes, but all these matters are fully covered in individual bulletins, and this paper has for its sole purpose the presentation of a rough, general survey of the whole field. The general economic conditions incident to the war played their several parts. The blockade of German ports, the withdrawal of maritime commerce, the congestion of shipping terminal facilities, the destruction of ships and cargoes, high insurance and shipping rates, the diversion of labor to military ends, Government restrictions and purchases, increased war demands for explosives, drugs and many other chemicals—all found their reflection in the price fluctuations.

Should Lead to Valuable Suggestions as to Future of American Chemical Industry

Finally, it may be stated that a careful consideration of these bulletins should lead to valuable suggestions regarding the future of American chemical industry. Wherein are we chemically independent? In what fields are we handicapped? What are the economic principles which should guide our legislators? Will capital take up the development of our chemical industries with the same thoroughness it has shown in other fields? What are the best measures to insure the permanence of an American dye industry? Numberless questions press for solution. To act intelligently we need, first and foremost, the *facts*. These bulletins make available the needed information on prices.

Oil Shales

By Louis Simpson

OWING to the continued steady increase in the consumption of hydro-carbon oils and the probable exhaustion of the world's oil fields at a date not very far distant, and because of the probable early exhaustion of certain of the fields as are most conveniently located, it has become necessary to seek for supplies of oil from other sources. No source at present known offers such possibilities as those of the oil-yielding shales and associated deposits containing oil found in nearly all parts of the world.

One quality of such shales has for over 50 years been mined and retorted in Scotland. The retorts used today in that country have been perfected to retort the special quality of shale mined, and take into consideration the very special conditions, industrial, commercial, financial and climatic, existing in Scotland.

As the cost of constructing the retort plant and the cost of operating are vital factors in the commercial operating of such plants, it was natural that engineers and others should devote time to the construction of retort plants that would retort the quality of shale found in countries other than Scotland at less cost, or with a larger yield of oil or a yield of oil of a more desirable quality. This is especially true since the Scotch retort, when erected outside of Scotland, has generally proved to be a failure.

For some reason not apparent, it has been usual for those who have reported or written upon the oil shales question to recommend the use of the Scotch retort and practice and the employment of Scotch engineers, even when they had no experience other than that they had gained in Scotland, and this in the face of the fact that the works erected outside Scotland and which have proved to be failures have chiefly been operated by Scotch officials.

Scotch Retort Methods Not Applicable Everywhere

The object of this article is to explain why Scotch retort methods and experience should no longer be considered the last thing in oil shale retorting and why it is necessary that an open mind should be kept when seeking for the best method of retorting a known deposit of shale.

The differences in local conditions are so extreme and are of such character that the blind adoption of any retort should be precluded, even though the retort has been used for years under certain local conditions, as in the case of the use of Scotch retorts by Scotch operators. These differences are found not only in the quality of shale to be retorted, which varies not only as to the extent and character of volatile contents but also as to the extent of nitrogen and carbon contents (the character of the shale itself also varies), as well as in the conditions under which the shale is to be retorted.

It must be evident to every thinking man that a retort may work well when retorting shale that contains, say, 25 gal. of crude oil to the ton and yet may not work satisfactorily when retorting a shale that contains 50, 60 or even more gallons to the ton. Also it is evident that a retort that will operate satisfactorily when retorting shale that contains only 2 to 4 per cent carbon may not be an economic apparatus when retorting shale that contains between 20 and 30 per cent carbon.

It should require no argument to prove that a retort that may be an economic means of recovering the contained nitrogen from shale and that will give a yield of 50 to 75 lb. of sulphate of ammonia to the ton shale might cease to be an economic apparatus when operating on shale that will yield only from 20 to 30 lb. of sulphate of ammonia.

Varying Local Conditions Should Be Considered

The quality of shale and of the associated deposits found throughout the world varies within very wide limits, as is above indicated, but the local industrial, commercial, financial and climatic conditions vary as greatly. It is not safe to assume that any new idea, because it is different from those adopted in Scotland by the Scotch oil shale operators, is worthless or that it is not worthy of adoption.

Up to date, there is only one commercial method by which oil is recovered from oil-yielding shale, but there have always been many different applications of the principles that govern the method, and the future will probably see nearly as many different applications as there are different qualities of shales. This method consists of the exposure of shale (placed in a closed chamber to which an exhauster is connected) *to the action of heat*, afterward condensing and working the gases so educed.

Other methods of extraction have been considered, but up to date none has warranted commercial demonstration, but it does not follow that in the future there may not be discovered a method which, by extracting the oil contents from shale that for diverse reasons cannot be retorted, may become of commercial interest.

The retorts now used in Scotland have been in operation about 20 years, and more than one make of retort is being used. It is not unusual to be told in reports that "the Scotch retort has been in use for over 50 years," which, of course, is a gross misstatement.

Variations in Methods of Retorting

All the retorts that up to date have been used commercially employ the same principle, the differences being only in the methods of application used. The variations occur in the methods employed:

1. To place the shale within the retort.
2. To remove the spent shale.
3. To apply the required heat.
4. To produce the required heat.
5. To conserve the heat.
6. To remove the educed gases.
7. To condense the educed gases.
8. To wash the gases that resist condensation.

In every commercial proposition the secret of ultimate success will be found in the most economical application of material and appliances suitable for the work, which, perhaps, have been in use in other industries (although unknown to the Scotch operators) or which have recently been discovered.

The question of whether the nitrogen contents of this shale should be fully recovered or otherwise is not argued here. That is a financial and commercial problem requiring an article to itself, but it is well to remember the industrial axioms:

1. That it seldom pays to seek to recover the last percentage.
2. That, with few exceptions, it is not wise to try to save by-products unless the profits received from such recovery equal or exceed the profits that would accrue from the investment in the original business of the money expended in the recovery.

Of the variations in the application of the methods above noted the following may be said:

1. The raw shale may be fed green or dried and may be fed intermittently, that is, the shale may be charged, then educed, and after eduction be discharged, or it may be fed semi-intermittently, as is done in the Scotch retorts, where a batch of shale is dumped into the retort every so many hours, but without any break in the work of eduction, or it may be fed continuously, as in the Del Monte and some other retorts.
2. The spent shale may be removed intermittently or continuously.
3. The heat may be supplied from combustion chambers surrounding the retorts, the heat in such case having to pass through the walls of the retort, or it may be furnished by the admission of preheated fixed gases into the retort.
4. The required heat may be produced by the use of methods too numerous to mention, the best method being that which consumes the least fuel and calls for the fewest repairs.
5. The art of conserving the heat units supplied to the retort has been much neglected in Scotch practice.
6. The removal of the educed gases may be provided for in different ways, but that used by the Scotch is one of the least scientific or desirable, and was only adopted because the method used in Scotland to recover the nitrogen content of the shale necessitated the use of large quantities of steam within the retort. But for this use of steam for another purpose, it would never have been used to assist in the removal of the educed gases.
7. The condensation arrangements, as used in Scotland, are not satisfactory, even under the conditions that exist in Scotland, and are impossible under climatic conditions known to exist in certain districts of the North American continent. The Scotch use atmospheric condensation. The variations experienced in the temperature of the atmosphere in Scotland rarely exceed 60 deg. F., and yet sometimes trouble is experienced. Since temperature variations in parts of this country exceed 120 deg. F. and even 150 deg. F., the use of atmospheric condensers here would be an impossibility. To obtain the best results the work of condensation must progress at the same rate under varying weather conditions.
8. Washing the fixed gases for the recovery of naphtha is a minor question, but one that should not be ignored. In this, again, Scotch practice is not the best, even though Scotch machine builders are producing one of the best mechanical washers known.

It probably is not possible so to design a retort plant that it will contain all the most desirable applications, and the most desirable ones only, but the retort of the future must at least possess a large majority of the most desirable applications, and must also be capable of being quickly constructed, and at a cost very much lower than the present cost of the Scotch retorts.

Conclusions as to Most Desirable Practice

Of the several variations in the applications noted, the most desirable will certainly be found to be:

1. Continuous feed of dried shale.
2. Continuous removal of the spent shale.
3. Heat supplied through the medium of a preheated gas.
4. A method by which this heat can be supplied without subjecting the retort proper to the high temperatures used in the Scotch retort.
5. Where all heat is conserved to the fullest extent.
6. Where the educed gases are removed as soon as they are educed.
7. Where the educed gases are condensed, under conditions that permit of condensation at a constant and regular speed, and where the resultant oils are delivered fractionated into oils of four or more densities.
8. Where the washer, without long stoppages for cleaning or repairs, will clear the forced gases of all naphtha.

It is also very necessary that the plant should be so laid out that the ground covered is reduced to a minimum. This is necessary not only to reduce the

outlay upon pipes of all sorts, but also that the building (which should be of fire-resisting construction) may not be too costly. It is possible so to arrange that a plant with a capacity of 1000 tons of shale in 24 hours, including shale crusher, boiler and power house, but not including storage tanks, will not cover more ground than 2500 sq.ft.

Arrangements should be provided for the economical production of electric power in quantity sufficient to supply the requirements of the plant, including the mines and the transportation system, and also provide the works and the workmen's houses with electric light.

The question of the commercial recovery of the nitrogen in the shale will be considered in another article.

Oil Shale Industry

Owing to the increasing demand for information on oil shale, the Bureau of Mines has recently issued a short paper giving a general discussion of the subject, together with a comprehensive list of references, covering all the important articles published in the United States and Scotland, as well as numerous articles published in other countries.

The paper reviews the history of the oil shale industry in Scotland; presents the status of the industry in the United States; compares conditions in Scotland with those in this country and draws a comparison between the petroleum industry and the oil shale industry, since the former is firmly established in this country and the principal products to be obtained from oil shale are closely related to those obtained from petroleum. Economic features in the development of the industry are also brought out and discussed.

The paper also contains directions for testing shale for oil and ammonia yields, prepared by E. M. Bailey, chief chemist of the Pumpherston Oil Co., the largest producer of shale oil products in Scotland, and describes the methods in use by the United States Geological Survey for assaying shales.

Copies of this paper, the title of which is: "Notes on the Oil Shale Industry, With Particular Reference to the Rocky Mountain District," may be obtained by addressing the Bureau of Mines, Washington, D. C., or the Bureau of Mines Experiment Station, Salt Lake City, Utah.

Senate to Act on Water-Power Bill

There is a movement on foot among the members of the Senate to pass the water-power bill without respect to the difficulties which surround the present discussion concerning the League of Nations and other foreign relations matters and without respect to the inquiries which are now being suggested concerning the high cost of living and the demands of the railroad employees.

It is expected, among Senate leaders, that the water-power bill, which is known as House of Representatives resolution No. 3184, will be reported out by the Senate sub-committee, of which Senator Jones of Washington is the chairman, within a few days. Senator Jones has not yet returned to his work in the Senate from his visit to Seattle, but he is momentarily expected in Washington, and the best information obtainable concerning the water-power bill, according to the Washington report of the McGraw-Hill engineering publications, is that immediately upon his return action will be had upon the bill.

Flotation Monopoly in Spain

IT IS reported that Minerals Separation, Ltd., of London has made a contract with the Sociedad Minera y Metallurgica de Penarroya whereby the latter becomes the sole owner of Minerals Separation flotation patents in Spain. A new company has been organized for the development of the flotation business and it is understood that Minerals Separation has taken an interest in the new company as part compensation for the rights assigned. For the present, it is reported that the Penarroya company will retain the flotation process for its exclusive use, although licenses may be extended to others on terms which have not been announced.

The Penarroya company is said to be practically in control of the lead industry of Spain, owning or controlling every lead smelter in the country. Lead-ore producers are practically at the mercy of the Penarroya company, since ore cannot be shipped out of the country owing to the distance of most of the mines from the sea. As a consequence of this domination the attitude of lead-ore producers is antagonistic to the smelting monopoly. The acquisition of the flotation patents enables the Penarroya company to control the production of lead not only from ore but from concentrates as well, at least for the life of the flotation patents. This latter is of considerable importance when it is realized that the quantity of low-grade ores in Spain is far in excess of that available for direct smelting. In addition to the large deposits of low-grade ore there are enormous dumps in many districts which could be economically treated by the flotation process. The Penarroya company possesses a further advantage in maintaining this monopoly by reason of its association with the banking house of Bauer, which owns the railroads covering the great mineral district tributary to the Penarroya smelters, of which there is one in Linares, and two at Cartagena. This offers superior facilities for the movement of ore, coal and coke, all of which the company owns and produces. The smelter at Linares is owned by the Penarroya company, while the two at Cartagena are controlled by contract. As reported in this journal some months ago, a new smelter is to be erected at Penarroya by Bradley, Bruff & LaBarthe, San Francisco engineers. It is expected that this smelter will be ready for operation early in 1921.

At the fourteenth ordinary general meeting of Minerals Separation, Ltd., held July 3, the chairman, Mr. Francis L. Gibbs, said:

> The large business which lies before us in Spain, which, as you are aware, we are commencing with the assistance of the Sociedad Minera y Metallurgica de Penarroya, has required considerable organization, and for this purpose we are fortunate in having been able again to secure the services of Lieut.-Col. A. C. Howard, D.S.O., M.C., of our engineering staff, who has served with much distinction throughout the war and who has been appointed our resident chief engineer in Spain. With a staff of our engineers, Colonel Howard is actively engaged in bringing to the notice of mine-owners in Spain the great advantage to be gained by the adoption of our methods of concentration. One of the most important matters upon which Colonel Howard and his staff will be engaged during the next few months is the investigation by means of drills of a very large copper concession over which we, in conjunction with the Penarroya company and other powerful groups, have acquired an option. Captain Broadbridge, our chief engineer, examined this concession, and both he and the Penarroya company's engineer report the existence of immense quantities of low-grade copper ore, which can be successfully treated by our processes. Development of this concession is being energetically pushed.

Relation of Microstructure to Phase Changes in Heat-Treated Aluminum Bronzes

Description of the Influence of Heat Treatment on the Microstructure and Other Physical Properties of a Cu-Al Bronze of the Composition 90 Per Cent Copper and 10 Per Cent Aluminum —Adaptability of This Bronze for Bearing and Corrosion-Resistant Metal

By L. R. SEIDELL* and G. J. HORVITZ†

OF THE aluminum bronzes ranging in aluminum content from 9 to 15 per cent, the most important commercially has the composition 90 per cent Cu and 10 per cent Al. This bronze when subjected to heat treatment exhibits interesting variation in microstructure and other physical properties. Previous investigation has demonstrated that with slight variations in the aluminum content above or below this composition wide variations in physical properties of treated and untreated bronze are also obtained.

Our tests, however, were confined to the alloy having the composition 90 per cent Cu and 10 per cent Al, and were carried out as follows:

1. Differential heating and cooling curves were obtained.
2. Specimens were quenched in water at intervals of 100 deg. F. from 800 to 1800 deg. F. and brinelled.
3. Specimens quenched at 1600 deg. F. were drawn at temperatures ranging from 700 to 1500 deg. F. and brinelled.

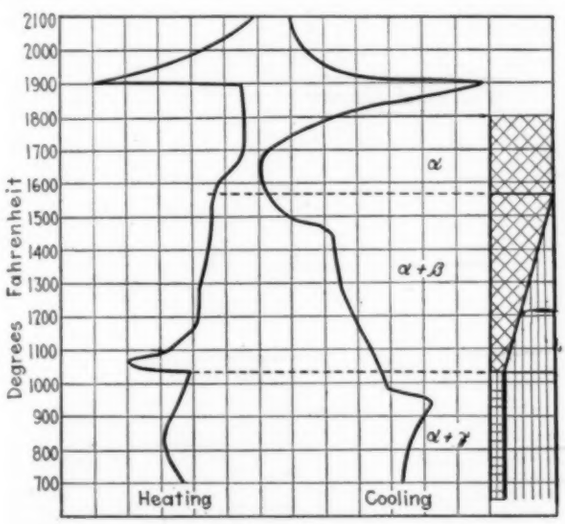


FIG. 1. THERMAL DIFFERENTIAL CURVES AND CONSTITUTIONAL DIAGRAM

4. Microstructure of representative heat-treated specimens was studied.

Thermal Differential Curves

On heating, the first phase change occurs at 1030 deg. F. and is due to transformation of $\alpha + \beta$ to $\alpha + \gamma$, all of which are solid solutions. The next change takes place at 1550 deg. F. This is much less pronounced than the first and represents the point at which absorption of the α into β solid solution is complete. Upon reaching 1895 deg. F. liquation sets in with a consequent large absorption of heat.

On cooling, the point at which α begins to separate from β agrees closely with the corresponding point on heating. However, there is a lag of about 50 deg. F. at the β to γ phase change.

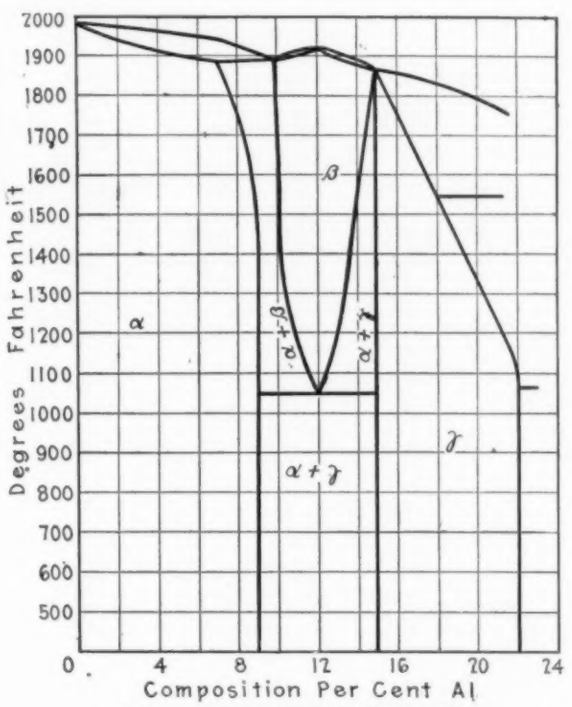


FIG. 2. EQUILIBRIUM DIAGRAM

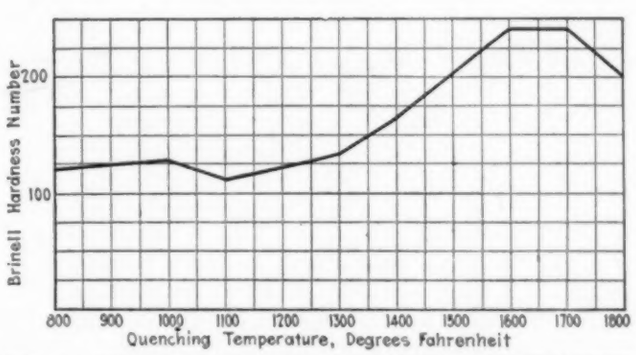


FIG. 3. BRINELL HARDNESS, QUENCHING TEMPERATURE

The constitutional diagram shown beside the heat curves in Fig. 1 represents the nature of the physical constituents present in the different ranges. Below 1030 deg. F. about 17 per cent γ and the remainder α

*Managing Director, New York Testing Laboratories.
†Metallurgist, New York Testing Laboratories.

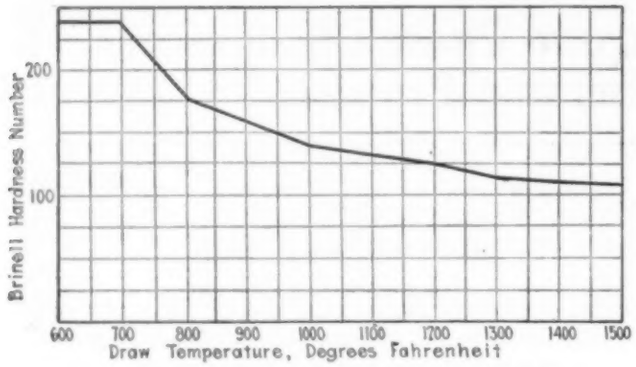
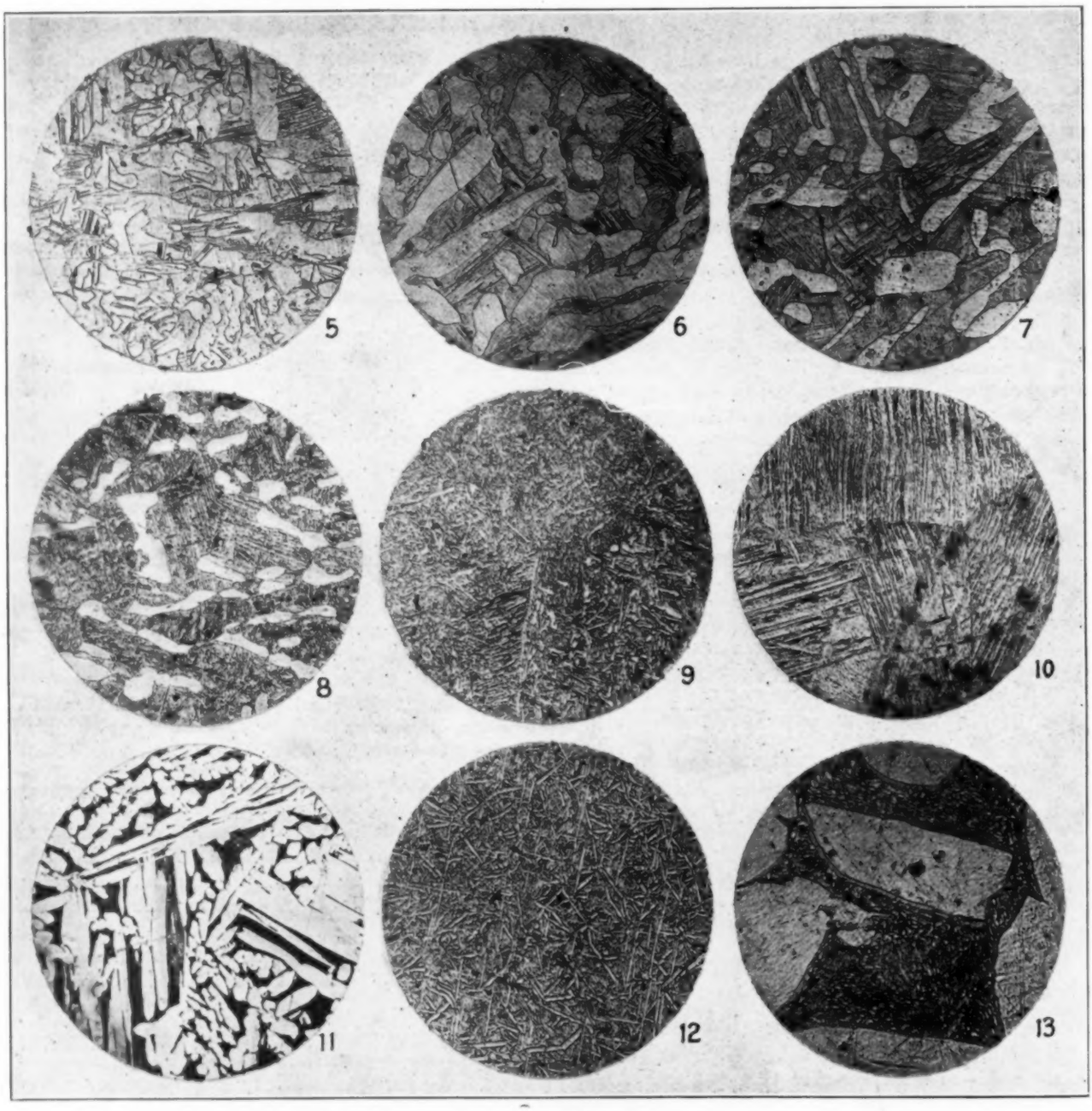


FIG. 4. BRINELL HARDNESS, DRAW CURVE

are present. Above 1030 deg. F. areas formerly γ solid solution are now β. As the temperature rises above this point, α solid solution is absorbed into the β until 1560 deg. F. is reached, at which absorption is complete and structure is 100 per cent β. By quenching from any temperature after holding for a sufficient length of time to insure equilibrium, the nature of the constituents will correspond to those indicated in the diagram for that particular temperature. The phase changes of the thermal curves coincide closely with those of the equilibrium diagram of this particular alloy.

This diagram, first worked out by Curry in 1907, and as generally accepted in the form illustrated in Fig. 2, shows α which is soft and ductile up to 9 per cent



FIGS. 5 TO 13

Fig. 5—Brinell 112; 1100 deg. quench; × 100. Fig. 6—Brinell 133; 1300 deg. quench; × 100. Fig. 7—Brinell 163; 1400 deg. quench; × 100. Fig. 8—Brinell 205; 1500 deg. quench; × 100. Fig. 9—Brinell 240; 1600 deg. quench; × 100. Fig. 10—Brinell 200; 1800 deg. quench; × 100. Fig. 11—Brinell 118; as cast; × 50. Fig. 12—Brinell 140; 1600 deg. quench, 1000 deg. draw; × 100. Fig. 13—Brinell 98; annealed at 1600 deg.; × 200.

and $\alpha + \gamma$ from 9 to 15 per cent aluminum. β ranges from 10 to 15 per cent, with eutectoid point at 12.5 per cent and 1051 deg. F. β has greater tensile strength than either α or γ with correspondingly low ductility.

A series of specimens $\frac{1}{2}$ in. thick were cut from a bar $1\frac{1}{4}$ in. in diameter. These were quenched in water at temperatures ranging from 800 to 1800 deg. F. Brinell hardness tests were made on each sample and a curve of results plotted (Fig. 3).

Specimen No.	Treatment	Brinell (1000 kg.)
1	As cast	118
2	800	121
3	1000	128
4	1100	112
5	1200	121
6	1300	133
7	1400	163
8	1500	205
9	1600	240
10	1700	240
11	1800	200

The hardness curve follows the phase changes closely and is maximum when the alloy is in the β condition.

To determine the effects of tempering on quenched samples, another series of specimens were water-quenched at 1600 deg. F. and drawn at temperatures from 700 to 1500 deg. F. A curve (Fig. 4) plotted from results of Brinell hardness test showed little drop in hardness up to 700 deg. F. Between 700 and 900 deg., however, maximum drop in hardness occurred. From 1100 to 1500 deg. there was little change.

Specimen No.	Water-Quenched at 1600 Deg. F and Drawn at	Brinell (at 1000 kg.)
1	700	230
2	800	178
3	900	157
4	1000	140
5	1100	133
6	1200	125
7	1300	115
8	1400	110
9	1500	108

The following are indicative of physical properties of this alloy as cast and heat-treated:

Treatment	Elastic Limit Lb. Sq.In.	Ultimate Strength Lb. Sq.In.	Elongation per Cent
As cast	15,000	60,000	28.5
*W. Q. 1470	31,000	98,000	8.0
*W. Q. 1650	55,000	95,000	3.5
*W. Q. 1650 (drawn at 930 deg. F.)	49,000	86,000	12.0
*W. Q. 1650 (drawn at 1300 deg. F.)	41,000	80,000	22.7

That heat treatment greatly improves the strength of this bronze is borne out by the above figures.

Microstructure

The structure represented in Fig. 5 is that of a specimen quenched at 1100 deg. F. The solid solutions α and β are present, the α crystals showing considerable twinning. Figures 6, 7 and 8, of specimens quenched at 1300, 1400 and 1500 deg F., respectively, show progressively smaller α crystals as the quenching temperature rises. This is due to absorption of α into β as stated above. Quenching at 1600 deg. F. results in practically all β (Fig. 9), while still higher temperatures merely increase grain size and impart a striated structure to the crystals as indicated in Fig. 10.

A comparison between the structure of the bar as cast and after heat treatment explains in part the cause of considerably greater tensile strength in the case of the treated bronze. The former shows massive primary crystallization of α and γ (Fig. 11) and the latter, quenched at 1600 deg. F. and drawn at 1000 deg. F., a close-grained mixture of needle-shaped α crystals in a matrix of β (Fig. 12). Prolonged annealing at 1600 deg. F. results in α and eutectoid of α and γ (Fig. 13).

The foregoing results suggest the advisability of investigating this alloy for use as a bearing metal. In this connection a structure such as that shown in Fig. 8 may be found desirable. This alloy also may be substituted for steel parts, where special qualities, such as resistance to corrosion, are desired, since in the heat-treated condition its strength compares favorably with that of steel.

Bibliography

Carpenter and Edward, *Jour.*, Inst. Mech. Eng., 1907.
Curry, *Jour. of Phys. Chem.*, 1907.
Guillet, Les Alliages Métalliques.
Rosenhain & Lantsberry, *Jour.*, Inst. Mech. Eng., 1910.
Andrew, *Jour.*, Inst. of Metals, 1915, Vol. 13, No. 1.
*Portevin and Arnon, *Revue de Métallurgie*, 1916, Vol. 13, No. 2.
Greenwood, *Jour.*, Inst. of Metals, 1918, Vol. 19, No. 1.

Electrical Conductivity and Other Properties of Saturated Solutions of Copper Sulphate in the Presence of Sulphuric Acid

By H. M. Goodwin and W. G. Horsch

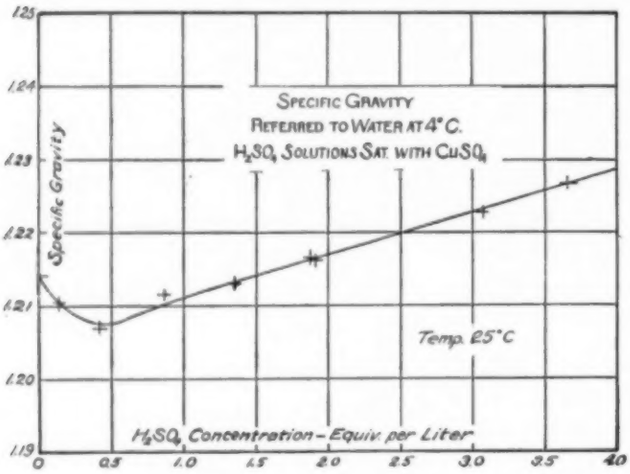
THIS paper gives the specific electrical conductance at 25 deg. C. of solutions saturated with copper sulphate and containing sulphuric acid ranging in concentration from 0.15 equivalent to 3.6 equivalents per liter. The solubility of copper sulphate in the presence of the sulphuric acid and the specific gravity of these solutions are also given. It was intended originally to extend the measurements over a range of temperatures, but circumstances having thus far prevented, it is thought desirable to publish and make available the results already obtained. The calculation of the conductivity of such concentrated mixtures is, in the present state of our knowledge of the degree of ionization of the salt and acid in the presence of each other, practically impossible if accurate results are desired.

The solutions used for these measurements were prepared in wide-mouthed, glass-stoppered bottles of 250 cc. capacity by adding to 200 cc. distilled water an excess of copper sulphate crystals and the desired (approximate) amount of 95 per cent sulphuric acid. Chemically pure sulphuric acid and copper sulphate from a well-known manufacturer were used. The copper sulphate was further purified by two crystallizations. Each bottle was rotated for 2 hr. in a constant temperature bath held to within $\pm$ 0.02 deg. of 25 deg. C. At the end of this time the conductivity of the solution was measured without removing the solution from the bottle or the latter from the thermostat. It was then rotated for an hour longer and the conductivity again measured. This procedure was continued until the conductivity became constant, which constancy was taken as the criterion for saturation having been reached.

The customary Wheatstone bridge arrangement with a slidewire of the drum type was employed in making the conductivity measurements. A generator furnishing sine wave alternating current at a frequency of 300 cycles per second served as the source of current. The conductivity cell was formed by introducing a pair of plunge electrodes, held rigidly with respect to each other, directly into the wide-mouthed bottle in which the solution was rotated. Each electrode consisted of a cylinder of platinized platinum held about 2 cm. from the lower end of a glass tube of about 1 cm. inside diameter. Be-

low the electrodes the tube was drawn down to 0.5 cm. inside diameter for a distance of 1.5 cm. The bulk of the resistance occurred within these projecting tubes, and the "cell constant" was independent of a reasonable amount of displacement from the normal location of the electrodes in the bottle.

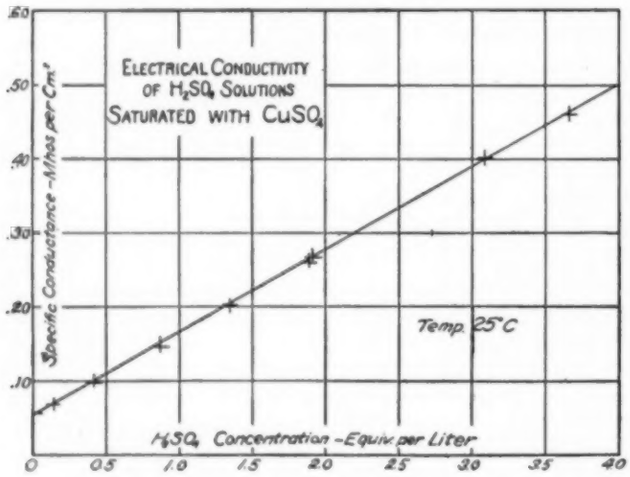
The cell constant was determined by measuring the conductivity of a sulphuric acid solution of maximum conductivity and of a normal potassium chloride solution. The average of the two methods of calibration was used in computing the results, the percentage deviation of the


Specific Gravity
Referred to Water at 4° C.
H_2SO_4 Solutions Sat. with $CuSO_4$
Specific Gravity
Temp. 25° C
H_2SO_4 Concentration – Equiv. per Liter

mean cell constant being less than 0.25 per cent. The precision of the final conductivity results is about 0.5 per cent.

The density of the solutions was determined to ± 0.1 per cent by means of a Mohr-Westphal balance. The results are given as specific gravity referred to water at 4 deg. C.

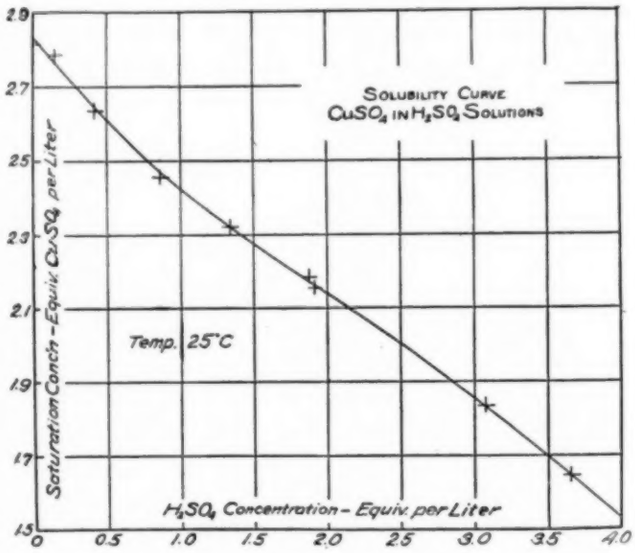
The copper sulphate content of the solutions was determined by electro-analysis, using, in some cases, a platinum dish as cathode and a rotating platinum anode, and in others a rotating platinum cathode which consisted of a 100 cc. platinum crucible suitably mounted. It was hoped at first that the acid content of the original



solution might be obtained by titrating for total acid after the removal of the copper and subtracting the acid equivalent to the amount of copper deposited. Test experiments showed this method to be inaccurate, however, by from 1 to 2 per cent, due largely, probably, to secondary reactions occurring during the electrolysis. The method was therefore abandoned, and the acid titrated with sodium hydroxide solution in the presence of the copper sulphate using methyl orange as indicator. One might expect the end point to be so masked by the blue color of the copper in the solution as to render the method inaccurate, but by sufficiently diluting the solution it was found that perfectly consistent results could be obtained. When acid, the solution appears a deep purple; when alkali it is green; the end point chosen was that at which a trace of pink could be detected in the green solution[1]. The sodium hydroxide solution was standardized by titrating against a standard sulphuric acid solution, which in turn was standardized against anhydrous sodium carbonate.

The results, shown graphically in the plots, are given in the following table:

Temperature, Degrees Centigrade	Concentration H_2SO_4 Gram Equivalents per Liter	Saturation Concentration $CuSO_4$ Gram Equivalents per Liter	Specific Conductance in Mhos.	Density Referred to H_2O
25.00	.....	2.818	0.05555	1.2140
25.00	0.1488	2.784	0.06884	1.2105
25.00	0.4208	2.634	0.09845	1.2070
25.00	0.8680	2.457	0.1458	1.2115
25.00	1.345	2.320	0.2023	1.2130
25.01	1.876	2.181	0.2608	1.2165
25.00	1.914	2.153	0.2671	1.2162
25.02	3.077	1.837	0.4005	1.2229
25.01	3.659	1.649	0.4596	1.2267


Solubility Curve
$CuSO_4$ in H_2SO_4 Solutions
Saturation Conch. – Equiv. $CuSO_4$ per Liter
Temp. 25° C
H_2SO_4 Concentration – Equiv. per Liter

Conductivity determinations on solutions containing various concentrations of sulphuric acid and copper sulphate and at various temperatures are covered by the following references:

Hollard, *J. de Phys.*, 5, 654 (1906).

Richardson and Taylor, *Am. Electroch. Soc. Tr*, 20, 179 (1911).

Addicks, *Electrochem. & Met. Ind.*, 4, 17 (1906). (Now consolidated with CHEM. & MET. ENG.)

Thompson and Hamilton, *Am. Electroch. Soc. Tr.*, 17, 289 (1910).

For the effect of sulphuric acid on the solubility of sulphates see Engel, *Comptes Rendus*, 104, 507 (1887).

Electrochemical Laboratory,
Massachusetts Institute of Technology,
Cambridge, Mass.

[1] To indicate the degree of precision with which this titration can be carried out in a solution containing copper ions, the following results are appended:

Titration of NaOH vs. H_2SO_4, no copper present		Titration of NaOH vs. H_2SO_4 in presence of $CuSO_4$	
1 cc. NaOH =	0.9605 cc. H_2SO_4	1 cc. NaOH =	0.9541 cc. H_2SO_4
	0.9594		0.9574
	0.9572		0.9585
Mean,	0.9590	Mean,	0.9567

The deviation of the two mean results is less than one-quarter of one per cent

Japanese Porcelains From Chemical Point of View, and How to Improve Them*

EXHAUSTIVE investigations have been made by Yaichiro Kitamura on Japanese porcelains which have been known to possess the following compositions by authorities on ceramics since Hermann A. Seger's reports in the *Tonindustrie Zeitung* in 1891:

Bodies..... 0.3—0.4 RO. 1 Al_2O_3. 6.2—7.4 SiO_2
Glazes..... 1 RO. 0.41—0.55—0.59 Al_2O_3. 3.66—4.42—5.04 SiO_2

The research of Oscar Kosert, published as a book, "Nippon Togio" (Technology of Japanese Pottery), is a valuable contribution. His investigations were solely based on bodies. One of the results of his investigations was to show that the way of obtaining samples was not satisfactory. The non-uniformity of the burning temperature in different parts of the kiln is great in Japanese kilns as compared with those of European types.

The varieties of bodies and glazes burned in Japanese kilns are plural and not single, as is generally found in Europe. At least two or three, sometimes four or five, varieties are found, each of which has a different burning point to meet the different temperatures of the successive sections of the kiln. For this reason, a great number of samples of varieties are important for the study of Japanese porcelain. There are a few reports as to the chemical compositions of Japanese porcelain; however, they do not give clear information about the bodies and glazes.

Y. Kitamura has devoted many years in confirming the chemical compositions of samples of all varieties from all representative localities, covering all typical lines of Japanese porcelain. From the investigations, he concluded some other formula than that of Seger should be applied to them.

Tables I and II show the analytical results of the bodies of fifty-nine varieties—8 from Aichi, 35 from Gifu, 8 from Saga Prefecture, and the rest from Kioto, Idzushi, Tobe and Hira Kiyomidzu. The limits of compositions in their molecular formula classified according to their localities are shown in Table III.

He analyzed all crude glazes before burning. There are 8 samples from Aichi Prefecture, 8 from Saga, 4 from Ehime and 5 from Yamagata. Their chemical compositions are given in Table IV.

TABLE I—CHEMICAL ANALYSIS OF JAPANESE PORCELAIN BODIES

(Descriptive details of minor importance about the variety of the samples are omitted by the abstractor)

No. of Sample	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss on Ignition	Total
Aichi Prefecture									
1	66.96	21.58	0.74	0.31	0.10	3.82	1.67	4.89	100.07
2	67.75	20.62	0.64	0.32	0.10	4.21	1.87	4.47	99.98
3	69.27	19.30	0.69	0.50	0.12	4.52	1.92	3.77	100.09
4	68.89	19.30	0.67	0.53	0.18	4.75	1.60	4.17	100.09
5	69.29	18.46	0.66	0.64	0.12	4.60	2.09	4.19	100.05
6	69.37	18.95	0.72	0.76	0.14	4.31	2.21	3.67	100.13
7	70.79	18.10	0.64	0.23	0.20	4.38	1.01	4.65	100.00
8	69.18	18.76	0.67	0.44	0.12	4.34	2.92	3.91	100.34
Gifu Prefecture									
9	65.80	21.56	0.89	0.23	0.05	3.92	2.71	5.07	100.23
10	67.92	20.11	0.78	0.23	0.06	4.23	2.80	4.16	100.29
11	68.74	19.52	0.76	0.29	0.08	4.29	3.15	3.59	100.42
12	64.49	23.00	0.56	0.39	0.16	4.09	2.89	4.76	100.34
13	66.42	21.24	0.44	0.80	0.07	4.21	2.95	4.04	100.17
14	66.54	20.81	0.47	0.57	0.14	4.92	2.13	4.52	100.10
15	69.80	18.73	0.70	0.37	0.25	4.28	2.29	3.45	99.87
16	70.26	18.25	1.04	0.32	0.14	4.30	1.51	4.37	100.19
17	66.68	21.28	0.78	0.33	0.17	3.89	1.50	5.48	100.20
18	67.81	20.31	0.82	0.39	0.15	4.15	1.65	4.63	99.81
19	68.27	19.33	0.75	0.42	0.14	4.47	2.09	4.50	99.97
20	67.75	20.12	0.86	0.31	0.05	4.70	1.91	4.53	100.23
21	71.72	17.33	0.82	0.26	0.06	4.72	2.35	3.17	100.43
22	68.23	20.22	0.63	0.46	0.06	3.79	2.47	4.51	100.37
23	70.53	18.44	0.55	0.33	0.15	3.81	2.35	4.06	100.22
24	70.26	18.39	0.58	0.40	0.07	4.68	2.52	3.51	100.41
25	65.74	22.42	0.55	0.21	0.07	3.87	2.19	5.22	100.27
26	66.55	22.08	0.59	0.29	0.09	4.02	2.24	4.33	100.19
27	66.42	22.12	0.44	0.17	0.05	4.38	2.32	4.21	100.12
28	66.37	21.60	0.52	0.16	0.06	4.53	2.50	4.52	100.26
29	65.81	22.41	0.61	0.33	0.12	3.78	2.82	4.38	100.26
30	63.58	23.03	0.63	0.68	0.15	4.52	2.10	5.32	100.03
31	65.92	22.10	0.67	0.56	0.06	3.38	3.49	4.11	100.29
32	70.87	18.61	0.49	0.41	0.06	4.30	1.73	3.74	100.21
33	69.12	18.25	1.11	0.23	0.10	5.75	2.00	3.48	100.04
34	69.45	18.32	1.42	0.34	0.07	4.06	2.57	3.80	100.03
35	67.92	19.72	1.03	0.63	0.05	3.90	2.57	4.25	100.07
36	65.75	21.46	0.61	0.73	0.17	3.67	2.96	4.70	100.05
37	66.69	20.55	0.88	0.36	0.10	4.14	3.12	4.24	100.08
38	66.22	21.42	0.82	0.24	0.08	3.72	3.00	4.61	100.11
39	68.37	19.87	0.72	0.34	0.05	4.90	2.61	3.40	100.26
40	68.85	19.41	0.67	0.34	0.07	4.87	2.82	3.36	100.39
41	64.67	22.86	0.64	0.51	0.30	2.80	2.86	3.34	99.98
42	65.32	22.52	0.40	0.45	0.15	3.35	3.10	5.77	100.06
43	65.88	21.70	0.32	0.79	0.28	3.14	3.68	4.35	100.14
Saga Prefecture									
44	73.31	17.15	0.86	0.67	0.30	3.86	0.59	3.26	100.00
45	69.13	19.53	0.80	0.75	0.34	4.29	1.30	4.08	100.22
46	74.74	16.93	0.89	0.14	0.16	3.48	0.39	3.47	100.20
47	75.37	16.20	0.89	0.39	0.08	3.34	0.78	3.14	100.19
48	73.56	18.53	0.49	0.32	0.04	3.20	0.51	3.29	99.94
49	74.78	17.64	0.59	0.20	0.05	3.07	0.70	3.06	100.09
50	74.87	17.26	0.67	0.37	0.06	2.77	1.01	3.51	100.52
51	76.24	16.64	0.76	0.36	0.09	2.25	0.62	3.40	100.36
Kioto									
52	73.54	16.62	0.52	0.20	0.07	4.06	2.08	3.11	100.20
53	75.46	15.57	0.63	0.24	0.12	2.90	1.88	3.40	100.20
54	70.36	18.99	0.81	0.25	0.10	4.53	1.34	3.80	100.18
Idzushi									
55	71.00	19.08	1.09	0.75	0.20	2.12	1.08	4.75	100.07
Tobe									
56	74.94	16.32	1.08	0.51	0.25	3.11	0.71	3.18	100.10
57	72.32	18.69	0.49	0.59	0.16	3.36	1.02	3.69	100.32
Hira Kiyomidzu									
58	74.64	15.67	0.69	1.08	0.51	2.02	2.02	3.44	100.07
59	73.10	16.54	1.18	0.97	0.34	1.82	1.62	4.44	100.01

TABLE II—CORRESPONDING MOLECULAR FORMULAE

No. of Sample	When Al_2O_3 = 1: RO	When Al_2O_3 = 1: SiO_2	When RO = 1: Al_2O_3	When RO = 1: SiO_2
1	0.36	5.26	2.80	14.73
2	0.41	5.57	2.43	13.54
3	0.48	6.08	2.08	12.65
4	0.48	6.05	2.10	12.68
5	0.54	6.36	1.86	11.84
6	0.53	6.20	1.88	11.67
7	0.41	6.63	2.46	16.33
8	0.57	6.25	1.77	11.01
9	0.43	5.17	2.33	12.03
10	0.49	5.72	2.06	11.77
11	0.54	5.96	1.85	11.00
12	0.45	4.75	2.23	10.58
13	0.52	5.22	1.92	10.01
14	0.49	5.42	2.03	11.00
15	0.52	6.32	1.93	12.16
16	0.44	6.52	2.25	14.69
17	0.36	5.31	2.73	14.66
18	0.40	5.66	2.50	14.14
19	0.49	5.98	2.05	12.28
20	0.44	5.71	2.25	12.85
21	0.56	7.01	1.80	12.63
22	0.45	5.72	2.20	12.60
23	0.49	6.48	2.06	13.32
24	0.55	6.48	1.81	11.73
25	0.37	4.97	2.68	13.36
26	0.40	5.11	2.51	12.80
27	0.41	5.13	2.46	12.62
28	0.44	5.21	2.28	11.85
29	0.43	4.98	2.32	12.03
30	0.43	4.68	2.31	10.79
31	0.48	5.05	2.09	10.54
32	0.45	6.45	2.21	14.27
33	0.56	6.42	1.79	11.48
34	0.52	6.43	1.94	11.77
35	0.49	5.84	2.03	11.82
36	0.49	5.14	2.02	10.40
37	0.51	5.50	1.95	10.72
38	0.45	5.24	2.23	11.67
39	0.52	5.83	1.92	11.16
40	0.55	6.01	1.81	10.87
41	0.41	4.79	2.42	11.61
42	0.44	4.92	2.27	11.14
43	0.50	5.14	2.02	10.41
44	0.42	7.24	2.41	17.42
45	0.45	6.00	2.24	13.46
46	0.30	7.48	3.34	24.99
47	0.36	7.88	2.79	21.97
48	0.27	6.73	3.71	24.95
49	0.28	7.18	3.55	25.50
50	0.32	7.35	3.15	23.16
51	0.26	7.76	3.83	29.79
52	0.50	7.50	1.98	14.86
53	0.45	8.21	2.23	18.29
54	0.41	6.28	2.43	15.24
55	0.31	6.30	3.20	20.18
56	0.37	7.78	2.67	20.78
57	0.36	6.55	2.75	18.04
58	0.56	8.07	1.79	14.42
59	0.44	7.49	2.33	17.07

*Abstract from "The Chemical Technology" (Kwagaku, Kogei), Vol 2, No. 7, July, 1918.

TABLE III.

	RO	Al_2O_3	SiO_2	No. of Samples
Aichi Prefecture	0.36—0.57 or 1	1 1.77—2.80	5.26— 6.63 11.01—16.33	8
Gifu Prefecture	0.36—0.56 or 1	1 1.79—2.73	4.68— 7.01 10.01—14 69	35
Saga Prefecture	0.26—0.45 or 1	1 2.24—3.85	6.00— 7.88 13.46—29.79	8
Kioto Prefecture	0.41—0.50 or 1	1 1.89—2.43	6.28— 8.21 14.86—18.29	3
Ehime Prefecture	0.36—0.37 or 1	1 2.67—2.75	6.55— 7.78 18.04—20.78	2
Yamagata Prefecture	0.44—0.56 or 1	1 1.79—2.33	7.49— 8.07 14.42—17.07	2

TABLE IV—RESULTS OF ANALYSES OF JAPANESE PORCELAIN GLAZES

No. of Sample	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss on Ignition	Total
				Aichi Prefecture					
1	72.49	13.48	0.42	3.79	0.18	3.53	3.34	2.98	100.25
2	69.47	14.33	0.37	4.66	0.30	3.25	4.07	3.86	100.31
3	68.84	14.73	0.23	5.54	0.25	3.58	3.53	3.62	100.32
4	75.52	10.92	0.24	3.40	0.17	4.71	2.27	2.86	100.09
5	72.45	11.11	0.27	4.77	0.26	4.42	2.76	3.94	99.98
6	69.56	11.67	0.25	6.18	0.33	4.80	2.62	4.71	100.12
7	76.26	9.98	0.46	4.04	0.27	3.45	2.42	3.30	100.18
8	65.02	12.08	0.46	6.61	0.37	5.75	4.17	5.60	100.06
				Saga Prefecture					
9	69.17	14.26	0.80	4.71	0.10	1.85	3.07	6.28	100.24
10	64.92	14.46	0.68	6.97	0.10	1.86	3.67	7.53	100.19
11	62.64	14.66	0.28	7.70	0.17	1.64	5.49	7.41	99.99
12	65.28	13.52	0.50	7.58	0.36	2.39	3.43	7.02	100.08
13	65.59	13.53	0.51	7.47	0.20	2.42	3.57	6.77	100.06
14	69.25	15.12	0.57	4.37	0.16	2.31	2.65	5.71	100.14
15	65.07	13.84	0.40	8.32	0.16	1.29	3.97	7.11	100.16
16	64.19	13.20	0.78	7.85	0.32	3.15	3.08	7.56	100.13
				Ehime Prefecture					
17	63.67	13.27	0.42	9.94	0.20	1.45	2.53	8.59	100.07
18	57.17	11.75	0.62	14.00	0.13	1.50	2.83	12.07	100.07
19	54.29	11.56	0.40	16.01	0.21	1.37	2.77	13.75	100.36
20	50.71	12.03	*	15.99	1.09	2.60	1.87	14.40	100.02
				Yamagata Prefecture					
21	66.72	12.66	0.59	7.86	0.62	2.01	1.60	8.12	100.18
22	62.51	12.61	0.87	9.70	0.70	2.12	1.90	9.62	100.03
23	59.62	12.13	0.83	2.73	0.72	2.07	1.63	2.29	100.02
24	56.78	12.07	0.65	13.53	0.84	1.92	1.66	12.71	100.16
25	55.27	12.45	0.78	13.96	0.91	1.83	1.89	12.89	99.98

* Fe_2O_3 0.94, MnO 0.38.

TABLE V—CORRESPONDING MOLECULAR FORMULAE

No. of Sample	When Al_2O_3 = 1 RO	SiO_2
1	1.24	9.11
2	1.36	8.22
3	1.39	7.92
4	1.42	11.72
5	1.66	11.05
6	1.82	10.10
7	1.58	12.94
8	2.16	9.12
9	1.11	8.22
10	1.45	7.61
11	1.72	7.24
12	1.70	8.18
13	1.67	8.21
14	1.01	7.76
15	1.70	7.96
16	1.79	8.23
17	1.83	8.12
18	2.75	8.25
19	3.09	7.95
20	3.14	7.14
21	1.63	8.92
22	1.97	8.39
23	2.32	8.32
24	2.62	7.97
25	2.64	7.52

The limits of compositions according to their localities are as follows:

TABLE VI.

Aichi Prefecture	1.24—2.16 RO	1 Al_2O_3	7.92—12.94 SiO_2
Saga Prefecture	1.01—1.79 RO	1 Al_2O_3	7.24— 9.12 SiO_2
Ehime Prefecture	1.83—3.14 RO	1 Al_2O_3	7.14— 8.35 SiO_2
Yamagata Prefecture	1.63—2.64 RO	1 Al_2O_3	7.52— 8.92 SiO_2
Total	1.01—3.14 RO	1 Al_2O_3	7.14—12.94 SiO_2

According to the above analysis, the Japanese porcelains have wider ranges of chemical composition both in bodies and glazes than have hitherto been believed by the ceramists. The new limits for them are as follows:

Bodies	0.26—0.57 RO	1 Al_2O_3	4.68—8.21 SiO_2
Glazes	1 RO 0.32—0.99	Al_2O_3	2.27—8.26 SiO_2

From the nature of their body materials, Japanese porcelains may generally be divided into two classes: those bodies consisting of strongly plastic clays (their commercial names are Gainome and Kibushi) of one or two kinds, or with feldspar and quartz; and those having bodies consisting of quartz porphyry, or decomposition products of igneous rocks resembling the above, or these together with some auxiliary materials.

The majority of the so-called Japanese porcelains belong to the first class, which cannot be expressed by the old formula, and Seger's formula applies only to porcelains of Saga Prefecture.

The composition of glazes, on the whole, shows a considerable discrepancy with Seger's formula, and the author's report furnishes definite information.

How to Improve the Porcelain From the Standpoint of Chemical Composition

To improve the porcelain, he took the physical properties into consideration, for instance the percentage of breakage during transportation, durability, etc. Further, he compared these analytical results of the Japanese porcelains with the best ones having international reputations and tabulated the formulæ as follows:

Japanese porcelain, first type	0.36—0.57 RO	1.00 Al_2O_3	4.68—7.01 SiO_2
Japanese porcelain, second type	0.26—0.45 RO	1.00 Al_2O_3	6.00—7.88 SiO_2
Sevres, Vienna	0.3 —0.35 RO	1.00 Al_2O_3	2.8 —3.5 SiO_2
Limoges, etc	0.2 —0.3 RO	1.00 Al_2O_3	4.2 —4.8 SiO_2

For the best European porcelain bodies the value of RO is 0.2—0.35 equivalent and that of SiO_2 is 2.8—4.8 when Al_2O_3 is taken as unity. The first class Japanese porcelain bodies contain more RO and SiO_2 than those of Europe and the second class Japanese porcelain bodies usually contain about the same value of RO and sometimes a little more, but considerably greater value for SiO_2 and sometimes almost twice as much as those of Europe.

The presence of an excess of basic components in a body lowers the softening temperature of the body and makes it vitreous, thus resulting in the disadvantages of poor resistance to shock and other mechanical treatment. The silica has the property of rendering the body brittle, if present in excess, to a much greater extent than alumina.

To improve the mechanical properties of Japanese porcelain one possible way is to correct their composition by changing the proportions of the raw materials and bring them nearer to those of the higher grades. For the first class Japanese porcelain bodies, the alumina comes from plastic clay (Gainome clay), basic components from feldspar, silica from quartz. An increase of alumina and decrease of bases and of silica mean, respectively, an increase of Gainome clay and a decrease of feldspar and quartz in the mixing operation of the raw materials. By increasing the percentage of Gainome clay over the present proportion, plasticity is increased. The dyeing and burning shrinkages become considerable and unfavorable color effect is found in the burnt products. For these reasons, it is practically impossible to obtain good bodies by increasing their content of alumina over the present proportion by using the old materials alone.

The discovery of these Korean clays is, indeed, an important contribution to the ceramic industry. Their properties, compositions and application in porcelain bodies are fully described in Reports No. 10 and No. 13 of the Industrial Research Laboratory, Department of Agriculture and Commerce, Japan.

For the second class of Japanese porcelain the raw

materials are simply quartz porphyry of varied decomposition. In order to decrease the percentage of silica, it is necessary to introduce aluminous materials into the old body clays. These body materials are generally not of strong plastic nature, so the addition of strongly plastic clay should be to a certain extent effective.

When the silica content is considerably too large, the introduction of alumina, necessary to counterbalance the brittling effect of silica, in the form of plastic Gainome clay is not satisfactory, because of excessive drying and burning shrinkages. It is advisable to apply strong plastic Gainome clay mixed with some weak plastic chosen Korean clay.

For those of the second class of Japanese porcelain bodies which have an excess amount of basic ingredients, the introduction of clayey substance reduces the percentage of base in the bodies, but for those not having an excess of basic ingredients, corresponding amounts of feldspar are necessary to maintain the desired percentage of bases.

Refractories Industry in Japan

By T. Kurahashi

WHILE every line of the chemical industry is rapidly growing and developing in Japan, the refractories industry has reached the highest development.

The manufacture of refractory material either in brick form or other is not a new industry there. About a thousand years ago Japanese began to manufacture refractories for iron and copper metallurgy, and made the

UNO FIREBRICK CO., INLAND SEA OF JAPAN

casting of the "Daibutsu," the gigantic bronze statue of Buddha. However, generally speaking, this industry is classified as one of the imported industries since Japan has opened her doors to Western civilization.

The Shinagawa Shiro-renga Kabushiki Kaisha (Shinagawa Firebrick Co., Ltd.) is the leading corporation of the brick industry and became the most important since the consolidation with the Nippon Yogyo Kabushiki Kaisha (Japanese Ceramic Co., Ltd.).

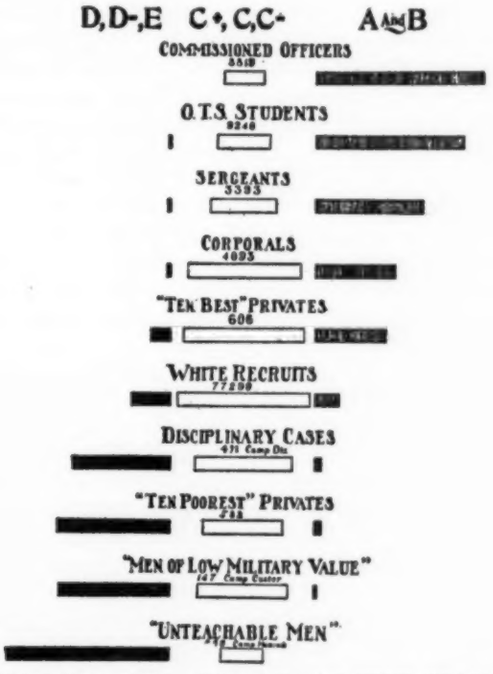
After the war broke out, and the chemical and metallurgical industries increased rapidly, many refractory plants were established. The Uno Taikarenga Kabushiki Kaisha (Uno Firebrick Co., Ltd.) is one of the most important.

Unfortunately, Japan has no variety of raw materials for special refractories, such as bauxite, magnesite, zanister, graphite, etc., so that most of the firebrick plants are not concerned in these special types of ware.

Tests of Men

WE GIVE herewith a few graphs taken from a recent number of *Science* on the "Measurement and Utilization of Brain Power in the Army" as developed by Major Robert M. Yerkes. They refer to psychological tests made of men in the Service, and their value is justified. They indicate: grade A, very intelligent; B, intelligent; C+, above average; C, average; C— below average; D, unintelligent, and D— and E, a mental age of from 7 to 10 years.

Without doubt the tests might be improved upon for special purposes, and those that are given do not include enough in number to demonstrate complete general averages. Nevertheless, as shown, they are confirmatory of what many of us have been thinking with more or less seriousness for a long time; that men in class D and under are not fit to rule. If all D— and E men had been rejected at the start, disciplinary cases would have been largely avoided, with all the delay, disturbances and expense attached to the proceedings;



PROPORTION OF LOW, AVERAGE AND HIGH GRADE MEN IN TYPICAL GROUPS

and the ranks of "poorest privates," "men of low military value," and "unteachable men" would have been greatly reduced.

We have been too neglectful of our D and E men and women in more ways than one. In mind they are children, and they are numerous, but we do not know how many they are, or which is which. The tests to determine this, though still inadequate, are better than we have been disposed to believe.

The present bolshevism and its associated I. W. W. anarchy are based upon the principle of rule by classes D and E. We make this as a postulate on the conviction that a psychological examination of the enrolled members of the I. W. W. by competent and impartial authorities would show a predominance of types D and E. It is easy enough to prove the contrary if the facts do not warrant the assertion. Now rule by men and women below type C is not to be endured unless those of types C and above are killed off, and then savagery is

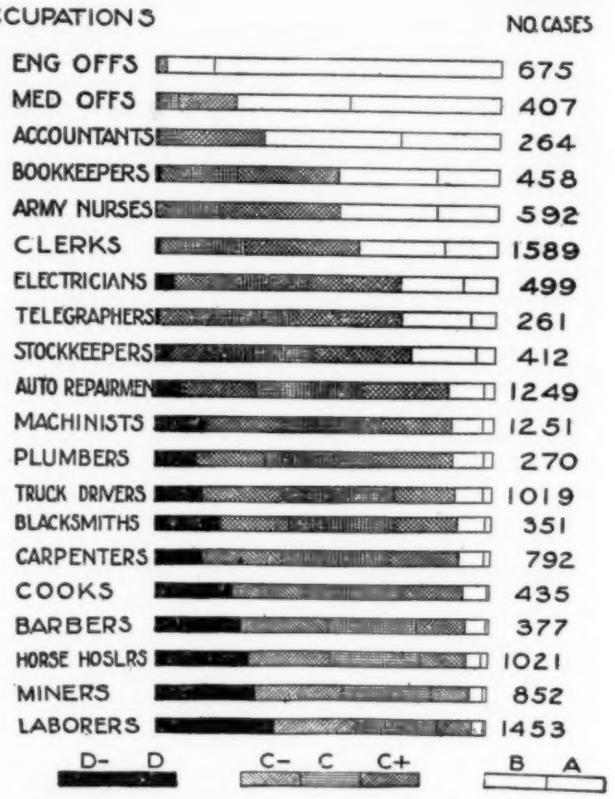
bound to prevail, for children are, in a way, savages. In parts of Russia this practice seems to obtain now. Efforts have been made to establish it in the textile cities of Lowell and Lawrence, Mass., and there has lately been an unsuccessful attempt to make a start of it in Seattle.

We must not think for a moment that a man is of class D or E because he is a laborer, or that he is out of these classes if he is rich and in authority. Note, please, that over half of the enlisted men are above C—, and that a large proportion of sergeants and corporals are in classes A and B. Also we must bear in mind the number of commissioned officers in C and C+. We have not yet discovered the golden rule to fit men in places where they belong, but these tests seem likely to help us toward it.

The tests are probably weakest in ethics and esthetics. With the latter we have not much to do as yet in industry and engineering. But with ethics we have constantly to do; and ethics has a wider scope than the Ten Commandments of Exodus. The A and B mind may be unethical, and cause a veritable deluge of disaster without ever reaching the stage of discipline. The war and all its consequences are directly traceable to the disregard of ethics by the German nation and its people. Tests are unlikely to be a gage of ethics, because nearly everybody, whether good or bad, or wise or stupid, claims to be just and fair, and will use what intelligence he has to prove it in examination. Justice and fairness are functions of ethics. The chances are, however, that minds of the A and B types, even if unethical, will avoid doing things that will get them into trouble, and that their acts will be guided by the ethical standards of public opinion.

Here we have a new method of gaging men that is free from favoritism, and that judges each one for what he is. It does not ask who his father was, or whether he is rich or poor. He does not require a college degree or a high school diploma to rank A, nor will a doctorate in philosophy assure him of this standing. It provides a means to aid in avoiding incompetence in authority. But at the same time it carries with it certain obligations.

Two duties lie immediately before us in industry, and they are pressing, exceedingly pressing. We must test out the men we employ in order to fit them into

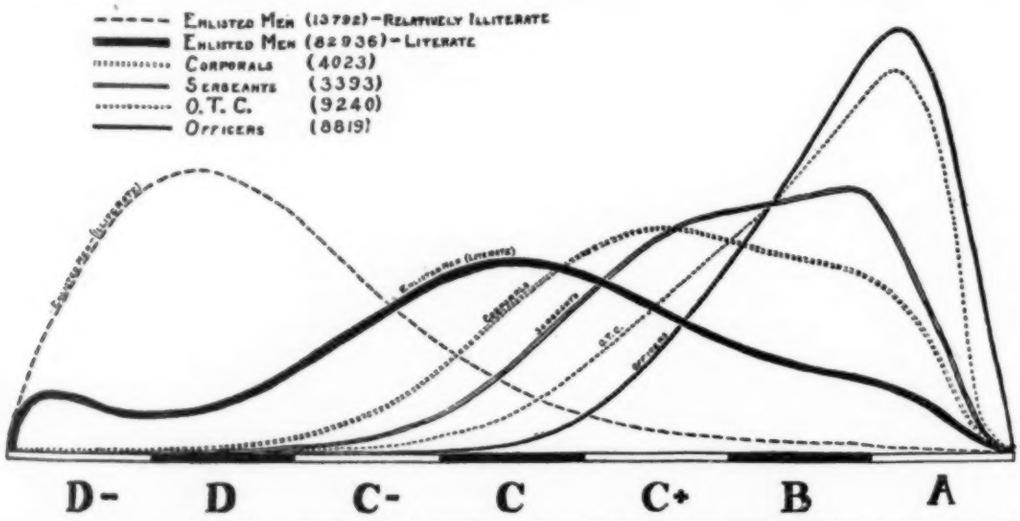


RELATION OF OCCUPATION TO INTELLIGENCE

their proper places. We must get rid of the system of hiring and firing by foremen, and we must know our men better.

That is one duty. The other is, we must set apart work that can be performed, at a living wage, by the D and E classes of men. They must be cared for, and watched, kindly but firmly. They should never be put into places of authority, whether they be rich or poor; and every such case should be tested and recorded. Then the A and B men should have the first chances of advancement, provided they are physically fit, and ethically adequate.

Crooks belong to a special class by themselves, and only the Lord and Tom Osborne know what to do with them.



DISTRIBUTION OF INTELLIGENCE RATINGS IN A TYPICAL ARMY GROUP, SHOWING THE VALUE OF THE TESTS IN THE IDENTIFICATION OF OFFICER MATERIAL

Some Points Regarding Calorimeter Efficiency*

Description of the Sources of Calorimetric Errors—Advantages of Different Types of Calorimeters for Moderately High Precision Commercial Work—Practical Conclusions—Superiority of a Calorimetric Installation With a Stirred, Thermostated Jacket and an Electric Thermometer

By WALTER P. WHITE

THE use of the calorimeter is to-day extending rapidly, especially for fuel testing. At the same time some new types of calorimeters are being introduced whose value varies greatly, according to the work to which they are put. There is thus a double reason for considering the sources of calorimetric error and the advantages of different types of instrument. The present paper attempts this task, and does so with reference rather to the moderately high precision desirable in commercial work than to the higher precision attained in special researches.

Calorimetric experiments are practically always done by passing the heat to be measured into a known mass of water and observing the resulting temperature rise. The heat, ΔQ, is then determined in accordance with the well-known equation $\Delta Q = C\Delta\theta$, where $\Delta\theta$ is the temperature change and C the capacity for heat of the calorimetric body; that is, of the water together with the containing vessel. This determination would involve nothing but a couple of temperature measurements were it not for the fact that there is no insulator for heat, and therefore there is practically always some heat flowing to or from the calorimeter. This thermal leakage must be determined, usually by a combination of observations and calculations. It causes less actual error than is often supposed, but it dominates the whole subject of calorimetry, and is responsible for nearly all the characteristic features of calorimetric practice. Thus, in order to treat the leakage in a definite way the surrounding temperature must be controlled more or less; then, in order to prevent the leakage from making the calorimeter temperature non-uniform and therefore uncertain, there must be stirring, which is the reason for using a liquid. This, in turn, may bring difficulty from evaporation and irregular stirring, and, finally, some temperature differences remain uncorrected (especially in the solid parts) constituting "lags," which are, mathematically, the most complicated part of the whole subject, though they can, fortunately, be handled very simply in work of moderate precision.

Sources of Error

Aside from blunders and exceptional occurrences, the sources of error in ordinary calorimetry seem completely covered by the following list:

A. The main temperature measurements.
B. The value taken for the heat capacity of the calorimetric body.
C. The associated determination.
D. The thermal leakage or its consequences, including:
  a. Control of the external temperature.
  b. Control of the calorimeter temperature (i.e., efficiency of stirring).
  c. The heat produced by stirring (which may be irregular, owing to irregular speed of stirring).
  d. Evaporation.
  e. Lags, if neglected or varying.

Temperature Measurement

A. The temperature measurement seems to call for little comment, save perhaps to say that from two to four individual observations are needed, so that the final error may be two or four times that of a single reading, though the average final error will not be so large as that. Thus, a mercury thermometer, if accurate to 0.001 deg., will, in itself, give a precision of one per mille or a little better with a temperature rise of 4 deg.; this is, however, rather high precision for a mercury thermometer. The electric (resistance) thermometer will do better—about ten times as well with the best instruments in competent hands. It of course requires a more elaborate installation. Many observers, however, consider the precautions and corrections needed with it less objectionable than those involved with the mercury thermometer, and the extra precision of the electric thermometer is a desirable thing, even in cases where the other may seem good enough. A precision which is just enough and no more for the purpose in hand looks very shrewd and economical on paper, and may prove not unsatisfactory so long as everything goes well; but if unexpected errors need investigation or checks upon the accuracy are desired, as is pretty certain to happen sooner or later, it is exceedingly comfortable to have even a fourfold or fivefold excess of precision, and in as many departments of the work as possible. The thermo-electric thermometer is not only capable of higher ultimate precision than the resistance thermometer in measuring small temperature differences, but is, to judge from my own experience, more reliable, and less troublesome in its need for precautions, though in some other evident ways it is less convenient. The methods necessary with it, however, are not so generally understood, and it is not regularly manufactured at present.

Heat Capacity of the Calorimetric Body

B. For determining the heat capacity of the calorimetric body the practice of calibration by means of a known quantity of heat, obtained either electrically or by means of a standard substance, has so many advantages, and has already become so widely used, that no other seems to deserve consideration. With this method, if uniform conditions are preserved, the error of the calibration becomes little more than the average error of a number of determinations, which can be made as numerous as is desired.

C. The associated determination must be considered for a fairly evident reason. There is no such thing as

*Journal, Franklin Institute, Vol. 186, p. 279.

bottling up a quantity of heat for subsequent measurement; heat cannot even be passed, unchanged, directly from one calorimeter to another. The heat must be produced as measured, and the only way to give the measurement significance is to express it as a ratio between the quantity of heat and the quantity of the thing (reacting chemical, electric energy, etc.) yielding the heat. An error in one of the terms of this ratio has the same final effect as a corresponding error in the other. This is merely a formulation of what is pretty generally understood in individual cases. In commercial coal testing, for instance, it is generally recognized that the sampling of the coal is often the greatest source of uncertainty, and it is futile to strive for a calorimetric precision very far ahead of the uniformity which it seems worth while to seek in the sampling.

Thermal Leakage

D. The thermal leakage and its calculation are responsible, as has been said, for most of the problems and complications in calorimetry. In calculating, the leakage is taken as the product of the leakage modulus, or rate of leakage per degree of thermal head (thermal head is the difference of temperature between calorimeter and environment) multiplied by the integrated value of the thermal head for the experimental period. The standard method is to determine the leakage modulus by rating-period observations on the rate of cooling of the undisturbed calorimeter; if two such rating-periods are used, it is possible to determine the thermal head without measuring the environing temperature, provided this temperature does not change appreciably during the experiment. This precedure also eliminates the effect of the heat produced by the stirring, which would otherwise need especial attention. The method is familiar, and does not need detailed consideration here. This method is almost necessary if the environment consists of several indefinite bodies at different temperatures, but it involves having three observation periods. If, however, the leakage modulus is the same from day to day, and if the environing temperature is measured, or is kept at a known value by a thermostat, the leakage can, after suitable preliminary work, be determined merely from observations on the calorimetric temperature during the experimental period, and no other period is needed, unless occasionally as a check. Of course, this demands first that the environment be all at a single definite temperature—that is, practically, that it be a stirred body of water more or less completely enclosing the calorimeter (though with an air space between, of course), and second that the calorimeter always contain the same amount of water and always be located, to a fraction of a millimeter perhaps, in the same position within the jacket.

Accuracy of Special Method

To determine the leakage in this way not only saves time and labor, but may promote accuracy by eliminating the errors of the temperature measurements needed in observing the leakage rates. That is to say, instead of a rate determined separately with some error for each experiment, the observer uses a rate determined once for all with more accuracy by numerous experiments. Using this method, the Bureau of Mines observers have, as they state, usually attained in their regular routine procedure an agreement of 1 in 1000. Of course, this precision was realized only where the sampling error was eliminated. This method, it may be added, should not be relied upon in any particular installation until it has been shown that the leakage modulus is in fact as constant as it needs to be. Other things than the position of the calorimeter may be of importance here. For instance, if metallic parts of any kind run from the calorimeter through the jacket to the air of the room outside it, a change in room temperature is very apt to alter the leakage rate unless proper precautions are taken. Evaporation is prevented in the Bureau of Mines calorimeters.

If the determinations made are nearly the same day after day, the temperature during the experimental period will always rise along almost the same curve, and its integrated value may without error be taken as the same for any given total temperature rise. If, in addition, the jacket temperature and the initial calorimeter temperature are always the same, the integrated thermal head will always bear the same relation to the total temperature, and the amount of thermal leakage will be simply a certain constant (and small) percentage of the total temperature rise. No attention, therefore, need be paid to the thermal leakage in working up the results. This is essentially the Bureau of Mines procedure. This treatment of the thermal head saves only a little labor, not time or error. Another important variation of the general method is obtained when the total value of the thermal head for the experimental period is kept very small. Since this value of the thermal head is the multiplier of the leakage modulus, a small value of it makes uncertainty in the modulus of very little importance; hence accuracy is higher while at the same time the modulus need not be very constant. In order to keep the total value of the thermal head small, the calorimeter is started at a suitable temperature below that of the jacket; the head is then first negative and afterward positive. It does not seem practical to use this method without observing the thermal head, nor without preventing evaporation. Hence this variation is a little more laborious, as well as more accurate, than the other. It does not take appreciably longer, and it avoids the thermostat.

Control of External Temperature

D, a. The temperature change from leakage of a well-designed calorimeter of ordinary size will be less than 0.015 of the thermal head in 5 min.; hence for 5-min. experimental periods the uncertainty of the jacket temperature may be at least thirty times that in the principal readings. Evidently any difficulty there may be as to this temperature will be a matter of control or uniformity, and not of measurement.

Stirring

D, b and *c.* The matter of stirring seems fairly well covered by the recommendation of the joint committee on coal analysis of the American Society for Testing Materials and of the American Chemical Society[1], that the stirring be vigorous enough to heat the calorimeter nearly 0.001 deg. per minute, and regular enough so that the variation in heat is negligible. This is certainly sufficient with a reasonably well-designed calorimeter. The heat varies as the cube of the speed of stirring, so that a variation of 1 per cent in speed produces a variation of 3 per cent in heat production.

D, d. No data exist as to the relative probable error

[1] *Jour. Ind. & Eng. Chem.*, 9, 106 (1917).

from evaporation, but this does not seem likely to be serious in commercial work, so long as evaporated water does not condense on the cover and drop back into the calorimeter. The prevention of evaporation is very desirable in work of high precision and is easy enough to be reasonable in nearly all cases, since it can be effected, without the introduction of any other error, by covering the calorimeter with an exceedingly thin metal cover. This cover need not bend down to touch the water, though it may well do so. If it does not, the water should be, to a millimeter, always at the same distance below it—say a centimeter. Covers of wood, rubber or other poorly conducting material have no other recommendation than possible cheapness. (See Walter P. White: "Calorimetric Methods and Devices," *J. Am. Chem. Soc.*, 40, 1888, 1918.) It does not necessarily follow that it is desirable to scrap such covers now in use, however.

Further Practical Conclusions

From the preceding discussion it appears that the uniformity of conditions in the uniform determinations of commercial work is almost sufficient in itself to secure precision, so far as thermal leakage is concerned, since effects which would otherwise be errors tend to cancel. The joint committee report cited above says that the calorimeter jacket "should" contain water which is stirred. There are two different reasons for this. The uniform temperature of a stirred jacket is, of course, desirable, but it might not seem necessary, since an unstirred jacket always started at the same temperature relative to room and calorimeter would be likely to give uniform results. But to have a jacket full of water which is stirred is the easiest way to provide for getting it at the same relative temperature each time; moreover, the provision of this particular feature is seldom likely to prove expensive.

To convert the stirred jacket into a thermostat is more expensive, since it requires a regulator and also demands if it is to be of real value that the jacket be brought above the calorimeter so as to surround it with practical completeness. But the gain in time and labor from using such an installation is very considerable.

The joint committee report advises having the initial calorimeter temperature so far below that of the jacket that the final temperature is less than a degree above it, and the total resultant thermal leak is near zero. Two advantages are attributed to this procedure; one, that evaporation is diminished; the other, that the total leak is small. The diminution of evaporation is as likely to increase the error as to decrease it[2], and the smallness of the total leak is practically of no advantage in the case treated, where two rating periods are supposed to be run, since in that case the total magnitude of the leakage has no effect on the error. This is proved in: Walter P. White: "The Conditions of Calorimetric Precision," *J. Am. Chem. Soc.*, 40, 1877, 1918. Little is lost by thus reducing the total amount of leakage, but it would be misleading, in considering the adoption of this method rather than some other, such as the Bureau of Mines method, to suppose that it had any real advantage in this particular direction.

It has been shown above that where a predetermined value of the modulus is used the reduction of the total amount of leakage does increase the accuracy. That case is not to be confused with the present one, where two rating periods are to be run (or three in all), and was not contemplated in the joint committee report. The reason for the difference in the two cases is this: With a predetermined modulus the heat of stirring is known, and so is the value of the environing temperature. When the direct thermal leakage is made very small its error is also made small, and there is nothing else normally affecting the calorimeter temperature, but with the 3-period method the heat of stirring and the effect of the environing temperature are determined along with the main thermal leakage, and so even if the main leakage is made to disappear the determination of these quantities remains, and its error is in fact about the same whether the total correction is large or small, since the term containing these quantities is not multiplied by the small value of the thermal head. A more complete explanation is given in the reference cited.

A calorimeter has been advertised as "adiabatic" which is characterized mainly by the use of a vacuum-jacketed glass vessel instead of the usual metal cup. To call such an arrangement adiabatic is pure humbug; it has a thermal leakage, which may be one-third or may be one-fourth as great as that of an ordinary calorimeter. To claim some advantage from the smaller leakage is legitimate; for it may enable an equal degree of precision to be reached with less care as to conditions.

Attempts are being made to utilize in commercial work calorimeters which are really adiabatic; that is, in which the jacket temperature can be rapidly changed and controlled so that it can be kept the same as that of the calorimeter during an experiment. Some of the proposed apparatus is admirable in its ingenuity and effectiveness, but there is still reason to doubt if it is worth while. The adiabatic method in calorimetry, like most methods in every subject, differs greatly in value according to the conditions of its use. In aneroid (fluidless) calorimetry and in long-timed determinations it is often absolutely indispensable, but in short experiments its value is much less. If we refer to the sources of error listed in this paper, *A*, *B*, and *C* are scarcely affected one way or the other by the adoption of the adiabatic method; nor are the temperature distribution effects *D*, *b*; *D*, *c*, and *D*, *e*. Evaporation (*D*, *d*) is greatly diminished, but easier ways have already been given of securing this result, which is not of first importance, anyway, in commercial work. The control of jacket temperature (*D*, *a*) will evidently be more perfect where this temperature is not greatly changed, so that here the adiabatic method is actually worse, though the inferiority is probably not serious. One real advantage of the adiabatic method is in ease, not precision, and consists in the avoidance of the labor of calculating the thermal leakage. But in commercial work this advantage is still more easily obtained through a thermostat, as at the Bureau of Mines. Of course, this method calls for a constant leakage modulus, which the adiabatic does not. But the results show that the chances of error from inconstancy of this modulus are very small. The most serious danger of variation in the modulus—that coming from the influence of room temperature changes—is quite as great with the adiabatic method. In uniform short-timed determinations, then, the adiabatic procedure, in return for the expense

[2]Owing to the fact that the leakage rate differs some 30 per cent, according as evaporation is or is not occurring; that is, suddenly becomes 30 per cent greater when the calorimeter temperature passes above the jacket temperature.

and manipulation it demands, appears to offer no advantage that cannot be more easily secured in other ways[3].

If a massive block of metal is used as the calorimetric body, equalization of temperature is less perfect than with a stirred liquid, but the difficulties and annoyances of stirring and evaporation are completely banished. The relatively imperfect equalization is evidently less serious in the uniform determinations of commercial work, so that for such work this kind of calorimeter might prove very desirable. Féry has proposed such an instrument, using the steel bomb alone as the calorimetric body, and measuring temperature thermoelectrically. In striving for simplicity, as it seems to me, he has attained an altogether unnecessary crudeness in several respects. Apparently, a much more accurate instrument could be realized which would not be harder to manipulate. The final success of such an intrument—that is, its net superiority to existing calorimeters—cannot be guaranteed in advance of actual experience, but the idea seems promising.

In conclusion, it may be said that a calorimetric installation with a stirred, thermostated jacket and an electric thermometer appears thus far to have given the best combination of precision and ease of operation, and that in the main the electric thermometer is responsible for the precision, and the thermostat for the ease of operation.

Geophysical Laboratory,
Carnegie Institution,
Washington, D. C.

An Adiabatic Bomb Calorimeter

By E. B. Holland,* J. C. Reed,† and J. P. Buckley.†

THE USE of calorimeters has become so general in both investigational and trade laboratories and the literature on the subject is so voluminous that it is with some reluctance that one offers additional material for fear of repeating what may have been more ably presented elsewhere. Some nine years ago the Massachusetts Agricultural Experiment Station secured a Berthelot-Mahler-Kroecker calorimeter with copper jacket and accessories, including pellet presses, Richter-Beckmann thermometers, Muencke balance, etc., for use in nutrition work and in the examination of fuels. The apparatus is too well known to require a detailed description. The bomb is of 300 cc. capacity and convenient to handle except in a few minor details. The porcelain lining is the most vulnerable feature. The jacket, however, did not permit the control of temperature required in an adiabatic calorimeter, and the reciprocating stirrer was unsatisfactory.

New Construction

A new double-walled copper jacket was constructed by E. A. Thompson of Amherst, the details of which are shown in the illustration. It is provided with an inlet for cold water, an overflow, a screw propeller stirrer belt driven by a slow starting electric motor of ⅛ hp., speed 1800, and a helical electrical resistance heater, which together permit complete control of the temperature of the jacket. The entire amount of water in the jacket circulates freely, as there is no dead space. The heater raises the temperature of the water 1 deg. C. per minute of current use. The cover is of a "two-step" type, copper with hard fiber top and partition, thus providing two superimposed dead air spaces. The thermometer and lens supports are of simple construction and very serviceable.

The copper pail, containing water in which the bomb, stirrer and thermometer are immersed, is insulated from the jacket and accurately centered by means of hard fiber supports. The pail, water, bomb, stirrer, etc., constitute the calorimeter proper, and the hydrothermal equivalent of the metal parts, enamel, glass, etc., together with the water, compose the bomb unit. A rotary stirrer of skeleton construction, with an offset for immersing the thermometer and two sets of blades inclined in opposite directions, effects with the baffle plates on the pail a spiral movement of water horizontally around the bomb. The stirrer is driven at low speed by a secondary belt leading from the screw propeller in the jacket and insures equalization of temperature without the production of an appreciable amount of frictional heat. The wires leading from the bomb are soldered to insulated cylindrical pieces of spring brass which slip over the terminals, displacing the screw connections, and pass out of the jacket through the driving shaft of the rotary stirrer to the desk terminals.

The calorimeter can be easily assembled or dismantled in a few minutes. The water and electrical connections permit convenient control of both screw propeller and rotary stirrers, temperature of jacket, thermometer tapper and ignition.

Thermometers

In the selection of new thermometers for determining the heat of combustion, choice lay between the normal type and the metastatic with an arbitrary zero, such as the Richter-Beckmann. The electrical resistance type which has since come in vogue seems to possess a high degree of accuracy and ease of reading, but was not considered at that time. The latter instrument was developed largely by the Bureau of Standards. The cost, however, precludes its use by many laboratories today.

Normal and metastatic thermometers of substantially the same length scale, 6 deg. range and 0.01 deg. divisions, could be readily procured and were presumably equally sensitive. The normal type of special construction was considered preferable and finally selected. The following specifications were furnished:

Approximate total length	24.0 in.
Length of scale, 16 to 22 deg. C	10.0 in.
Outside diameter on the scale	0.5 in.
Length below scale plate	8.0 in.

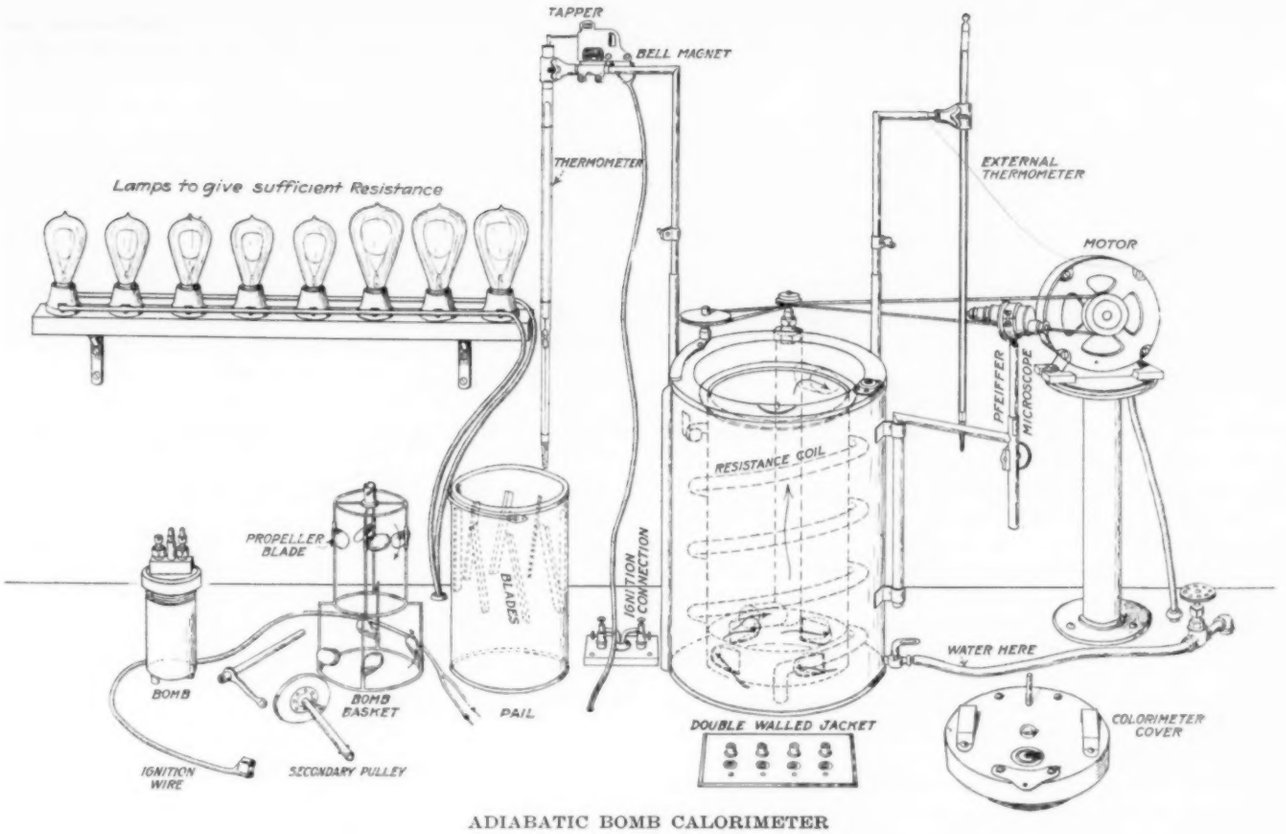
Each thermometer was provided with an expansion bulb, milk glass scale and a metal cap to permit the use of a tapper. After seasoning for several months the thermometers were tested by the Physikalisch-Technischen Reichsanstalt and a certificate of correction for each degree issued.

---

[3] In some recent work of high precision (*Journal Am. Chem. Soc.*, Vol. 39, p. 2110, 1917) the adiabatic method was adopted mainly because a stationary final calorimeter temperature was thought necessary for satisfactory reading of the resistance thermometer. It is safe to say that the necessity, in so far as it existed, may fairly be attributed to some deficiency or peculiarity of the electric installation used, and is not an inevitable disadvantage of that type of thermometer, although the usual installation is not the most convenient that could be used for reading changing temperatures. So far as the precision of commercial work is concerned, there appears to have been no general difficulty in reading changing temperatures, as is indeed shown by the disregard of the possibility of making their reading more convenient.

* Associate chemist, Massachusetts Agricultural Experiment Station.

† Assistant chemist, Massachusetts Agricultural Experiment Station.



ADIABATIC BOMB CALORIMETER

Almost any chemical thermometer graduated to 0.1 deg. C. on milk glass scale or stem will answer for determining the temperature of the water jacket, provided the instrument is reasonably accurate.

The tapper was constructed from an ordinary electric bell clamped to the arm of the thermometer support, the gong removed and a piece of soft rubber inserted in place of the hammer to reduce the force of the blow to the intensity desired. Wet and dry cells having proved unreliable, the tapper was run from a bell ringing transformer giving 5 to 10 volts, 0.75 amp. vibrating and 1.30 stationary. The application of the tapper a few seconds before each thermometer reading prevented any perceptible mercury "lag" or frictional error.

Lens

The lens sent with the original calorimeter for reading the thermometer scale was unsatisfactory. A Galileo telescope, a reading telescope and a so-called "laboratory microscope" were also tried with like results. The ideal instrument should be mounted horizontally, give a clear sharp field of appreciable size when applied to the opaque milk glass scale of the thermometer, not invert the object, magnify sufficiently at 0.01 deg. C. division of the scale (approximately 0.42 mm.), so that it can be readily and accurately divided into 10 parts or read to 0.001 deg. C. (probably equivalent to 15 to 20 diameters), and if possible have a focal distance of about 90 mm., so as to clear the side of the calorimeter jacket. Singly all these requirements were possible, but combined were rather difficult to meet.

The prism tube of a Pfeiffer's dissecting microscope with ocular 201 and a chromatic objective 1-a with special arrangement for varying the focal distance was finally secured. The combination gives a magnification of approximately 4.5 diameters, and a clear field of 48 mm. at a distance of 90 mm. The instrument as a whole is the most satisfactory of any tested, though lacking the necessary magnification. The latter fault will be remedied as soon as higher power can be secured, which so far has been impossible on account of the war.

Amherst, Mass.

Meeting of the Maritime Chemists' Association

At the meeting of the Maritime Chemists' Association held in Sydney, N. S., on July 15 and 16, Mr. A. F. Blake, chief chemist of the Atlantic Sugar Refineries, Ltd., St. John, read a paper on "The Evaluation of Coal," in which he developed an equation based on the analysis of the coal to determine the value as a fuel. He also showed a nomographic chart enabling the solution of the equation to be carried out with a minimum of effort.

Mr. I. C. Mackie, chief chemist of the Dominion Iron & Steel Co., Sydney, read a paper on "The Use of Benzol as Motor Fuel," which appears in a forthcoming issue of the *Canadian Chemical Journal.*

Dr. H. Jermaine Creighton of Swathmore, Pa., read a paper describing the Landreth direct oxidation process for the electro-purification of sewage, showed lantern slides of the plant and gave analytical and bacteriological data showing the efficacy of this method. He also gave cost data for an installation.

A paper by Dr. A. McGill of the Trade and Commerce Department on "The Chemists' War" was read by title.

Committees were appointed to deal with the question of the formation of a section of the Society of Chemical Industry and to approach the Government relative to the representation of the Maritime Provinces and its industries at the forthcoming Exposition at Chicago.

Notes on the Estimation of Metallic Zinc Content of Zinc Dust

By W. F. Edwards

BY USING the Franz Meyer apparatus and observing all of the numerous required details one can obtain quite accurate, consistent results in the chemical analysis of new (unused) zinc dust; and by the exercise of proper care and precautions fairly consistent results can be obtained also on zinc dust that has been used in the process of sherardizing.

However, everything taken into the consideration, the hydrogen gas method is not suited to the estimation of zinc dust, used or unused, in sherardizing. It requires too long time, too much attention to details and too much apparatus. Barometer readings, temperatures, vapor tension corrections, gas absorption corrections, etc., are necessary.

The method of estimating the metallic zinc in zinc dust by the reduction of potassium iodate in dissolving the zinc dust in a strong solution of fixed alkali and subsequent titration of iodine distilled from the acidified solution by sodium thiosulphate, in the main as given in the second edition of "Merck's Reagents, Their Purity and Tests," gives consistent results when proper attention is given to a number of details such as continued shaking during the solution of the zinc dust, proper cooling of the solution of potassium iodide in which the iodine is absorbed when distilled from the acidified solution, and proper attention to connections in and displacement of the air from the distillation apparatus. This method, like the hydrogen gas method, is subject to too many details to be a good working method in sherardizing or other commercial plants.

The Amalgam Method

The amalgam method gives very uncertain results, but in general it may be said to give too high per cents of zinc oxide and therefore by difference too low per cents of metallic zinc. As usually described the amalgam method depends on the titration of the excess of a measured quantity of standard acid, usually hydrochloric acid. It is not easy to get a definite end reaction in an acid solution containing zinc salts, as the zinc hydroxide formed does not show sharply enough the point at which the acid is neutralized by the standard alkali solution. By titrating the acid solution of zinc salts with standard solution of potassium ferrocyanide to obtain the zinc directly instead of by deduction from the amount of acid used, one can get a definite enough end reaction for practical purposes, if the solution is filtered before titration. However, the amalgam method can only be of value when carried out with careful attention to details in parallel estimations of the "unknown" zinc dust and standard zinc dusts of known metallic zinc content, under identical conditions of reagents, temperature and time. Even under such conditions the results are not even satisfactory for ordinary practical purposes.

The Ferric Ammonium Alum Method

The method of reduction of ferric sulphate in my hands gave very inconsistent results even when care was taken to run parallel estimations as nearly in the same way as practical. However, with crystallized ferric ammonium sulphate (ferric ammonium alum) I was able to get very satisfactory results both as to consistency and accuracy, the results comparing favorably with those obtained by the hydrogen gas method, the time being approximately 15 min. instead of from 6 to 36 hr., the approximate time limits for the gas method. The process is satisfactory when 1 g. of zinc dust is weighed into a 600 cc. Erlenmeyer flask and 50 g. of the ferric ammonium alum in crystals (the larger the better) and 100 cc. of water added. The mixture should be kept in constant stirring motion by giving a suitable motion to the flask. The crystals of ferric alum aid in stirring the zinc dust and will usually not all be in solution when the zinc dust is dissolved. As soon as the zinc dust is all dissolved add 100 cc. of 1 to 10 sulphuric acid and titrate with N/10 potassium permanganate solution. In case there are many analyses to be made it saves calculation to use a potassium permanganate solution each cubic centimeter of which represents 1 per cent of zinc on a 1 g. sample.

Comparison of Results by Different Methods

The results are quite accurate enough for the estimation of the metallic zinc content of used or unused zinc dust in sherardizing plants. The following analyses of used and unused zinc dust by the hydrogen gas method and the ferric ammonium alum method were made from the same sample in each case and show a very close comparison:

NEW ZINC DUST

Hydrogen Gas Method	Per Cent	Ferric Alum Method	Per Cent
No. 1	94.9	No. 1	94.7
No. 2	94.9	No. 2	94.7
No. 3	94.8	No. 3	94.6
No. 4	95.1	No. 4	94.5
No. 5	95.3	No. 5	94.6
Average	95.0	Average	94.8

USED ZINC DUST

Hydrogen Gas Method	Per Cent	Ferric Alum Method	Per Cent
No. 1	79.4	No. 1	79.7
No. 2	78.8	No. 2	79.6
No. 3	78.6	No. 3	79.7
No. 4	79.5	No. 4	79.8
No. 5	78.4	No. 5	79.8
Average	78.9	Average	79.7

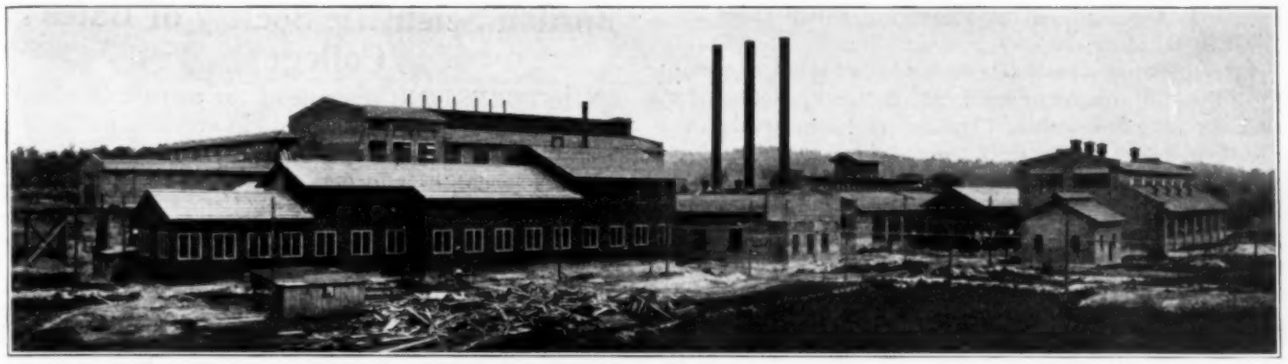
In the case of the hydrogen gas method on used zinc dust I was unable to get a completed reaction in less than 24 hr., the time being more often 36 hours. Attempts to speed up this method by using stronger acid than usual led to freak speeds that gave unsatisfactory results. I have not made any attempt to explain the freaks.

On the whole I think I am justified in stating that the ferric ammonium alum method of estimating the metallic zinc content of both used and unused zinc dust is quite satisfactory for all practical purposes.

Civil Service Examinations

Metallurgist.—A vacancy in the Bureau of Mines, Pittsburgh, Pa., at $2700 a year will be filled from this examination. In addition to a college degree, the applicant must have had four years' experience in metallurgy, at least two years of which must have been in aluminum and magnesium foundry and rolling practice. Applications must be filed by Aug. 26, 1919.

Research Chemist.—The duties of this position include research chemical work in connection with iron, steel and associated alloys or refractories and gases, as assignments will be made in the Ordnance Department at Large, War Department, for duty at ordnance establishments throughout the United States, at a salary of $2200-$2500. Examination closes Sept. 2, 1919.



PLANT OF KINGSPORT WOOD REDUCTION CO., KINGSPORT, TENNESSEE

A New Method of Distilling Both Green and Seasoned Hardwoods

OUR readers are more or less familiar with the Government's urgent need for large quantities of chemicals in its warfare activities. However, some of us may not have realized the extreme importance of acetone and acetates in our aircraft production program, these being essential ingredients in the dope applied to aëroplane fabrics.

The Government's requirements so far exceeded the nation's possible production from the available supply of dry or seasoned woods that the authorities welcomed a new process which would procure these and other products from green wood, sawdust or wood-waste quite as well as from seasoned cordwood. It takes about twelve months properly to season cordwood preparatory to destructive distillation by what we may now term the old line process.

The new process has for its chief points of advantage a method of briquetting sawdust or finely divided wood-waste and of distilling the wood briquets under controlled conditions of temperature and pressure in multitubular retorts.

The briquetting machines, the invention[1] of Mr. Otho C. Duryea, have been in use for about three years briquetting brass and copper borings and turnings at plants located at Waterbury, Conn., and Chicago.

The material is compressed in a specially designed press. One of the plungers of this press is driven against the compressed charge by the explosion of a gas-mixture in an auxiliary cylinder. The resultant impact produces the briquet.

Tests were made to satisfy the Government that sawdust, or "hogged" and shredded wood, could be similarly briquetted, after drying; that the supplementary processes of shredding, distillation in multitubular retorts, the recovery of pyroligneous acid and its constituents, wood alcohol and acetate of lime, were thoroughly practical on a large scale.

The Kingsport Wood Reduction Company contracted to erect and operate a plant using this process, the only one of its kind in the world. Accordingly a 35-acre site was selected near the city of Kingsport, Tennessee, in the mountains about equidistant from the Virginia and North Carolina boundaries. This location was chosen because it tapped an area in which a valuable supply of hardwood sawdust was available from the stores of mountain saw mills in the three adjoining States, also because of the large available supply of standing hardwood timber. The timber belt upon which the plant depends for its current supplies extends for more than one hundred miles in every direction.

Ground was broken in April, 1918. Buildings and equipment costing over a million dollars were rushed toward completion with such vigor that the armistice of the following November found the plant practically ready to make initial deliveries.

Handling the Raw Material

Trainloads of sawdust and wood-waste are received on an elevated trestle in drop-bottom cars, the cars being emptied into bins alongside the process building. The sawdust and fine material is carried by a conveyor direct to rotary screens located in the process building. The cordwood, either green or dry, together with slabs and other coarse wood-waste, is carried by conveyer into two "hogging" machines in the same building, where it is "hogged" and shredded prior to being briquetted. Both the sawdust and shredded wood pass through cylindrical screens and from these to special patented rotary driers by means of conveyor system. The driers are about 8 ft. in diameter and 60 ft. long and are heated by coal. Their operation is so flexible and efficient that however wet the entering sawdust may be the product emerges as a steady stream in a completely dried condition.

Briquetting the Processed Wood

From the rotary driers an automatic conveyor carries the dried sawdust and shredded wood up an incline into eight storage bins in the top of the press building. In this building is located a battery of eight briquetting presses, one for each storage bin.

The material feeds by gravity from each bin into a high-speed rotary shutter, which fills the briquet mold. Every two seconds the horizontal plungers of each of these machines move inward toward each other and when the eighteen inches of sawdust are compressed into a space of about five inches, the explosion takes place and the resultant shock, aggregating many tons to the square inch, impacts the material into a briquet two inches thick and four inches in diameter. The wood briquet weighs approximately one pound and is heavier than water.

Distilling the Wood Briquets

As the briquets are discharged from the presses, they roll down through chutes into a storage bin at one end of the adjoining retort building. Here a novel assembling device sets them on edge, like lozenges in a package, in angle-iron troughs 20 ft. long. The filled troughs are lifted onto a charging car, which is moved

[1] U. S. Patent, 1,220,733.

forward to the doors of the retorts, of which there are 26 in this building.

The retorts are a multiplication of steel tubes of about 6 in. internal diameter and 20 ft. long, heated by a battery of gas burners. The retort tubes are larger in their inside diameter than the wood briquets, to allow space for the escape of the gases and the heavier liquid products. As the charging car is brought in alignment with a retort, the front and rear retort heads are raised and a mechanical pusher shoves the briquets into the tubes, forcing the red-hot charcoal of the previous heat out at the other end of the tube.

A heat takes about two and one-half hours. The temperature is under such accurate control as to drive off each distillate at the temperature most favorable for both quantity and quality production. During the heat, hydraulic compression plungers exert a pressure against the charge of now plastic briquets. This control of the compression of the charge, together with the accurate control of heat, produces a charcoal of such density and uniformity that its power for absorbing gases has been hitherto unequalled. As the process developed, it was discovered that the tars and oils and their products take on equally unusual characteristics, which, it is claimed, will give them distinctive commercial value.

Recovering the Distillation Products

The gaseous product, pyroligneous acid, passes through copper piping from the condensers to the stills, while the tar is piped to the tar stills. Subsequent distillation of the pyroligneous acid produces acetic acid, wood alcohol, oil and tar residues.

The alcohol is pumped from the still house into two large steel storage tanks. The acetic acid is drawn off into mixing tubs, where it is combined with calcium oxide to form acetate of lime. Drum driers revolving in these tubs pick up a film of the solids, which are scraped off by a steel knife and deposited on a horizontal belt conveyer. This conveyer, in turn, delivers the pasty product to a broad endless drier belt formed of interwoven steel links which become covered and enmeshed with the plastic material. Drying is accomplished during the passage of this belt upward and downward through a series of gas heated tile flues extending from floor to ceiling of the tall building. The acetate of lime is thus baked onto the chain belt, and at the end of its travel it encounters a series of sharp turns which crack the caked acetate off the chain and deposit it in granular forms on a movable conveyer. It is then sacked and delivered by a chain conveyer directly into freight cars.

Refining the Tar

The tar from the retorts is carried directly to the tar stills, where it is refined and the creosote, oils, pitch and other wood-tar products are recovered. Provision has been made for enlarging and extending the tar distillation and refining facilities of the plant to meet the requirements of the various markets that may develop.

The plant as it now stands has a capacity for handling one hundred cords of hardwood per day, or its equivalent in sawdust and wood-waste. This is approximately two hundred tons of dry wood or from three hundred to four hundred tons of green or wet wood. With the cessation of hostilities the Government's demand for these essential products ended, but arrangements are being perfected for the operation of the plant along commercial lines by its builders.

Jordan Scientific Society of Bates College

AN INTERESTING example of the manner in which student organizations can aid in arousing public interest in scientific developments—particularly those of applied science—is afforded by the activities of the Jordan Scientific Society of Bates College at Lewiston, Me.

In 1918 an exhibition of some of the work done by members of the society was held, primarily for the purpose of interesting nearby high-school students in the college. The first exhibit proved such a success that this year the scope was increased to include local business men and the general public.

Every course offered in chemistry at Bates was represented by an exhibit with work being done by students just as it is done in the laboratories. Thus in general chemistry students prepared nitric acid, while in industrial chemistry various commercial analyses were carried out. In the advanced organic preparations several dyes manufactured in the college laboratories were shown. Lewiston is a thriving textile center with ten cotton and woolen mills, hence work in textile chemistry was featured at the exhibit, and more than one mill agent made favorable comment on this feature. National manufacturers have co-operated with the department of chemistry by sending permanent exhibits of their products and the raw materials entering into their manufacture until the department has over forty exhibits illustrating most of the important chemical industries. These were placed on exhibit with proper placards and formed one of the most interesting parts of the exhibit to the general public. In fact this exhibit was somewhat of a miniature reproduction of the National Chemical Exposition.

The programs of the society meetings were made more interesting by the use of moving pictures to illustrate papers. Films were obtained through co-operation with the Bureau of Commercial Economics and national manufacturers and included such subjects as "Operation of a By-Product Coke Oven," "Operation of a Pulp and Paper Mill," "Refining of Sugar," "Cyanamide Process," and "Cottrell Precipitation." In addition to papers explaining these processes, other members have given original papers on "Synthetic Rubber and Rubber Substitutes," "Dehydrated Foods," "Radium Emanations," "Use of the Spectroscope and Spectrometer in Spectrum Analysis," with plates prepared in the Bates laboratories; "Gas Warfare," and "The Fourth Dimension."

The Society was exceedingly fortunate in securing for one of its speakers Dr. H. E. Williams, research chemist with the S. D. Warren Paper Co. Dr. Williams spoke on "Black Liquor" and showed some of the products which he had been able to recover from it. Dr. Williams has the distinction of being one of the few men in the United States who is an authority on this phase of the paper industry.

This short sketch of the activities of the Jordan Scientific Society is given with the hope that some other college may find them as worth while as they have proved at Bates. Many of the large Western colleges are using moving pictures to good advantage; so far as is known, Bates is one of the few Eastern colleges to use films. The idea of an exhibit by a student organization of a college is believed to be original, but capable of great development.

Alignment Chart for the Gas Laws

By Alan G. Wikoff

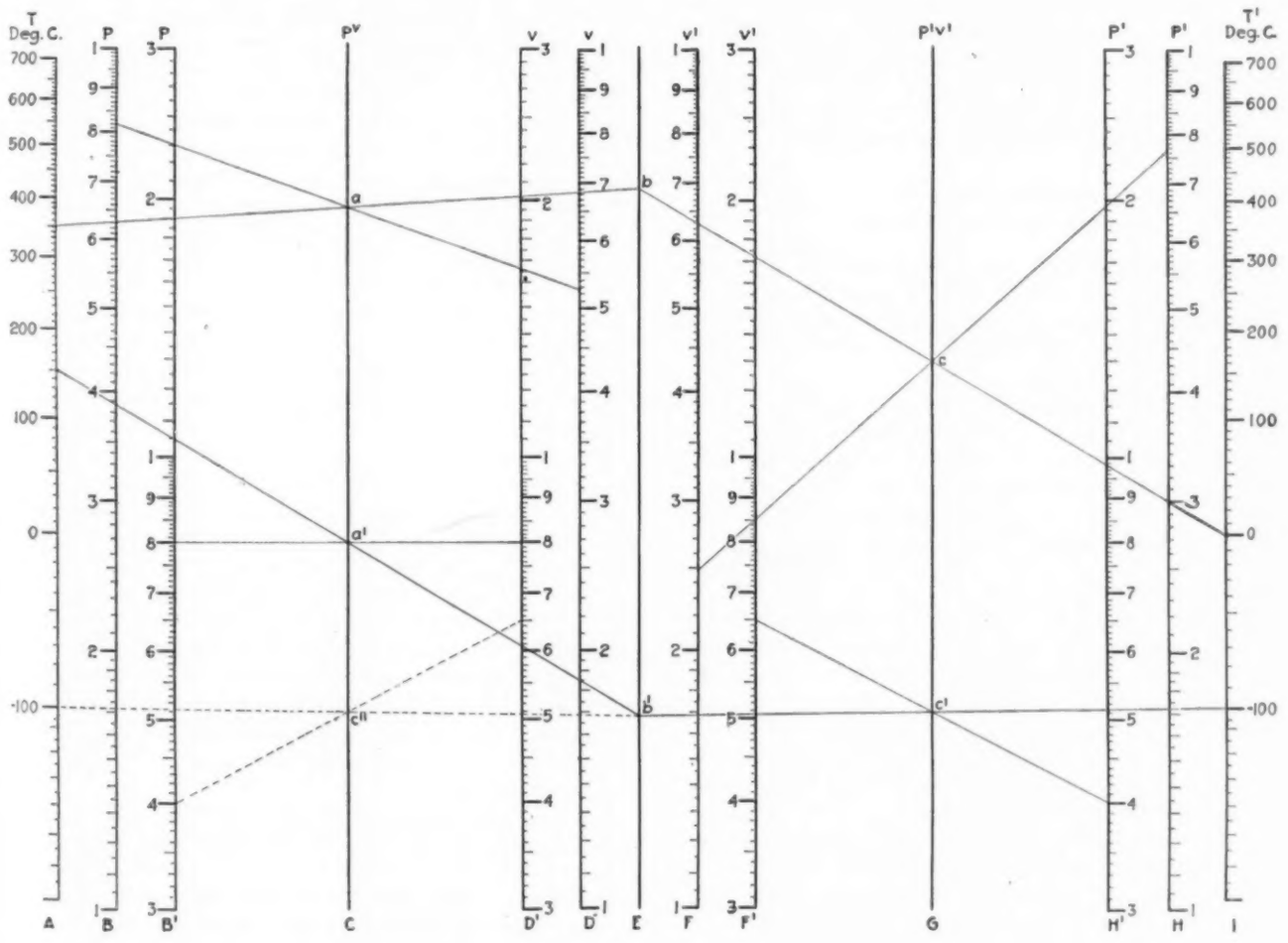
WHILE the Boyle-Mariotte-Charles law, $pv = RT$. is applicable with a high degree of accuracy only to the permanent gases at pressures below three atmospheres, the relation

$$\frac{pv}{T} = \frac{p'v'}{T'}$$

which is derived from this law, is constantly employed in practical work for the calculation of gas volume under different conditions of temperature and pressure. In the accompanying alignment chart for the solution of this equation, the necessity of converting deg. C. into deg. absolute is avoided by graduating the temperature scales A and I so that the scale reading in deg. C. corresponds to the logarithm of the absolute temperature.

There are two pairs of p, v and p', v' scales, one pair having the index at the bottom of the chart, the other near the center. The advantage of such a construction is evident when we consider the actual operation of the chart. Let the unknown be p', v' or T', all the other values being known. Starting with p, v and T, the product, pv, is first obtained by joining the numerical values of p on scale B and v on scale D by a straight line, giving a point of intersection on C. Since we are not interested in the numerical value of this product, this scale is not graduated. If this point on C is now connected with the value of T on A, we obtain a point on E which represents the quotient, $pv \div T$. Here again, the numerical value is not required. If T' is known, connect the value of T' on scale I with the point on E and obtain a point of intersection on G, which, aligned with the value of v' or p' (whichever is known) on F or H, gives the unknown on either H or F. If T' is unknown, first obtain the point $p'v'$ on G and align this with the point on E, giving the value of T' on I. If, when using scales B and D for p and v, the point $pv \div T$ does not fall within the limits of the chart on E, the values of p and v should be transferred to scales B' and D' and the corresponding pair F', H' used for v' and p'. (See example II below.)

Since the chart is symmetrical about E, all of the operations may be carried out on one side, as shown in example IIA. The extended form is given, however, in order that the principle may be more readily grasped.



Example I: Given 525 cc. of oxygen at 820 mm. and 350 deg. C.; what is the volume under standard conditions (760 mm. and 0 deg. C.)?

$v = 525$ cc. $\quad v' = x$
$p = 820$ mm. $\quad p' = 760$ mm.
$T = 350$ deg. C. $\quad T' = 0$ deg. C.

pv: Align 820 on B with 525 on D; obtain point a on C.
$pv \div T$: Align 350 on A with a; obtain point b on E.
$(pv \div T)\ T'$: Align 0 on I with b; obtain point c on G.
$(pv \div T)\ (T' \div p')$: Align 760 on H with c; obtain $x = 248$ on F.

Example II: Given 8 liters of a gas at 80 cm. and 150 deg C.; at what temperature would the volume be 6.5 liters when the pressure had been reduced to 40 cm.?

$v = 8$ l. $\quad v' = 6.5$ l.
$p = 80$ cm. $\quad p' = 40$ cm.
$T = 150$ deg. C. $\quad T' = x$

pv: Align 8 on B' with 80 on D'; obtain point a' on C.
$pv \div T$: Align 150 on A with a'; obtain point b' on E.
$p'v'$: Align 6.5 on F' with 40 on H'; obtain point c' on G.
$p'v' \div (pv \div T)$: Align b' with c'; obtain $x = -100$ on I.

Example IIA: Same problem as Ex. II showing method of solution, using only one side of the chart.

Obtain b' as above.
$p'v'$: Align 6.5 on D' with 40 on B'; obtain point c'' on C.
$p'v' \div (pv \div T)$: Align b' with c''; obtain $x = -100$ on A.

Uses of Manganese Dioxide Ore*

By W. C. Phalen

ESTIMATES of the quantity of manganese ore used in the industries other than the metallurgical industries vary from 25,000 to 50,000 tons per annum. The latter figure is probably more nearly correct. Most of the ore so used is the highest grade of pyrolusite (MnO_2) obtainable and commands a much higher price than metallurgical ore. The manganese dioxide ore is generally spoken of as chemical manganese ore.

The principal use of manganese ore aside from its applications in the steel industry in the form of ferromanganese and spiegeleisen is as an oxidizing agent. It is so used principally in the manufacture of dry cells, as a decolorizer in certain kinds of glass, and as a drier in oils, paints and varnishes. The ore is also used directly or indirectly in the manufacture of various manganese chemicals. Many of the textbooks describe its reaction with hydrochloric acid as a source of chlorine. It is no longer used commercially in making chlorine gas, as the latter is an abundant by-product in the manufacture of caustic soda and potash. Some chlorine may be made by this method when the object is the production, not of chlorine, but of manganese chloride. It has been mentioned as a soil stimulant, but its value in the fertilizer industry has not been established and so far as known it is not a constituent of any commercial fertilizers. Only those uses of commercial importance will be mentioned here.

The Dry Cell

General Description

To understand fully the rôle played by manganese dioxide in the dry cell, it will be necessary to explain the general make-up of the cell, the chemistry of the processes involved, together with the constituents entering into the reactions.

The modern dry cell, commonly but erroneously called the dry battery, is a portable modification of the "Disque" Leclanché cell invented by Leclanché about 1868. This consisted of a porous cup containing a carbon electrode and a mixture of rather coarsely ground retort coke and pyrolusite. The cup was sealed over, two vents being left for the escape of excess gases, and was placed along with a zinc rod in a glass jar containing a solution of ammonium chloride. Because of its simplicity and ease of operation, many attempts were made to fix the electrolyte in various media such as sawdust, gelatin, asbestos and silicic acid, so as to make it portable.

In 1888 Gassner brought out the first really successful dry cell. The positive pole consisted of a cylindrical mass of ground pyrolusite and coke packed in a canvas bag around a carbon electrode. This was placed in a zinc container which also served as the negative pole, and a paste of plaster of paris, zinc chloride and ammonium chloride was poured under and around it. After a short time, the paste would set and then the cell was sealed with a rosin or pitch composition.

The Gassner cell, though a great improvement over various other dry cells of the time, did not meet with much favor because of its high internal resistance and low voltage. The highest current that could be obtained was about 6 amp., and its voltage was about 1.3. Because of these facts, its use was limited to service requiring only small current drains.

Development

The advent of the gasoline engine gave the development and production of the present type of dry cell a great stimulus. Its use in ignition systems demanded a cheap portable cell able to recuperate after comparaitvely heavy current drains. In 1897 its manufacture attained considerable volume. The present normal yearly requirements of this production include about 25,000 tons of high-grade manganese dioxide ore, an equal amount of carbon (petroleum coke and graphite) and 8,000 to 10,000 tons of sheet zinc together with corresponding quantities of zinc chloride, ammonium chloride, paper, carbon electrodes, pitch and sundry other substances.

Method of Manufacture

In the modern American dry cell of the usual type, the negative pole consists of a cylindrical zinc can which also serves the purpose of a container. Several sizes are on the market, the great majority, however, being about 2½ in. in diameter by 6 in. high, (the so-called No. 6 cell). The inner surface of the zinc is lined with a special grade of absorbent paper, acting as a reservoir for the electrolyte, and has a diaphragm between the zinc and the positive pole. The depolarizing mass, called the "mix," is tightly tamped into the can around a centrally located carbon electrode to about 1 in. from the top. This "mix" is composed of ground carbon, usually calcined petroleum coke and graphite, manganese dioxide ore and the electrolyte. It, together with the carbon electrode, is the positive pole. After the mix has been tamped, the paper is turned down over the mix; sand or sawdust is poured in, to a depth of about ½ in. and the cell is sealed with a hot pitch composition. The object of the layer of sand is to provide an expansion chamber for the electrolyte and the excess gas, and also to provide a dry bed for the hot pitch.

Constituents Used

The zinc sheets used for the cans are substantially pure, prime Western spelter being generally used. The sheets are usually about 0.016 to 0.019 in. thick in the 2½ by 6 in. cells. Comparatively little of the zinc is used up during the service life of a cell. The mechanical strength to withstand filling and the fact that the can corrodes unevenly, in spots, patches or streaks, must be taken into account when considering the necessary thickness. One of the problems of the dry cell manufacturer is to construct the cell so as to make this corrosion uniform.

Most manufacturers at the present time use a special grade of pulp board for lining the cans. Blotting paper was formerly largely used, but is now employed in only few brands. The paper now generally used consists only of ground wood pulp and sulphite pulp, and is 0.03 to 0.04 in. thick. It should be porous enough to allow the electrolyte to diffuse readily through it, but still retain the smallest particles of carbon and manganese; and it should be capable of absorbing several times its weight in water. Furthermore, it should obviously be free from metallic particles.

The depolarizing mass or "mix" is the vital part of the cell. Its different components must be suitably

*Part of a comprehensive bulletin on manganese that is to be issued by the Bureau of Mines.

proportioned to render the most efficient service. They, together with their different functions, will be discussed in turn.

The ammonium chloride should be equal in purity to the usual chemically pure article. It should be substantially free from alkalis, sulphates, inert material and heavy metals. When the cell is discharging, by virtue of the carbon, manganese dioxide, and zinc couple, the ammonium chloride is split up into hydrogen, ammonia, and chlorine, which attacks the zinc can, forming zinc chloride. The reaction is:

$$Zn + 2NH_4Cl = ZnCl_2 + 2NH_3 + H_2$$

The liberated gases are the cause of polarization and will be discussed further, under zinc chloride and manganese.

The graphite used is generally of the artificial variety, several grades of which are prepared for use in dry cells. It does not enter into the chemistry of the cell, serving only with the coke to render the mix more conductive. The coke used is calcined petroleum coke, that is, residues remaining in petroleum stills. When raw, it is practically a non-conductor. However, on being calcined at a high temperature it becomes denser and as good a conductor as the better grades of amorphous natural graphite.

The relative fineness of the graphite, coke and manganese ore, together with their distribution, should be so uniform as to make the mix approach a solid porous mass. The current should flow along radial lines from the carbon electrode to every point on the surface of the mix adjacent to the paper lining. The ideal condition is to have each particle of manganese covered with a coating of carbon sufficient to render it a good conductor, but still porous enough to permit efficient depolarization, while the voids should be filled with the porous coke.

The zinc chloride should be of good grade, as free as possible from heavy metals. Its function is to depolarize the ammonia, which it does by the formation of double salts of zinc and ammonium chloride. No exact information is available as to the reactions involved, but it appears that a slightly soluble double chloride of zinc and ammonium is formed as the end product. During the earlier part of the service life of a cell, inefficient depolarization of the ammonia is probably often the cause of its failure under heavy drains. A cell that has been short-circuited or subjected to a heavy drain smells strongly ammoniacal when opened. Another cause of dry-cell failure is the formation of a highly resistant, non-porous crust between the paper lining and the zinc can, owing probably to the formation of the double salt mentioned above or the formation of zinc hydrate.

Rôle of Manganese

The function of the manganese is to depolarize the hydrogen. The reaction involved is usually given as follows:

$$H_2 + 2MnO_2 = Mn_2O_3 + H_2O.$$

It has been shown that the manganese reacts almost instantaneously in depolarizing the hydrogen, very likely while the latter is still nascent.

Character of Manganese Ore Used[1]

Chemical Requirements. There are several factors entering into the suitability of manganese ore for dry cells. It should have a high available oxygen content present in the form of pyrolusite (MnO_2), and a minimum amount of iron and should be free from copper, nickel, cobalt, arsenic, and other metals electronegative to zinc. Copper in particular is very harmful. If these impurities are present in the form of compounds insoluble in the electrolyte, they do no harm, other than being inert or poor conducting materials. If soluble, however, their solutions diffuse to the zinc can, where they are deposited, forming an electrocouple which results in local and useless corrosion of the zinc and consequent deterioration of the cell. When the cell is in service, the deterious action of these impurities is greatly hastened.

Physical Requirements. The physical properties of manganese ores also influence their suitability for use in the dry cell. It is generally conceded that an ore should be somewhat porous to perform its function efficiently. A somewhat hard but porous ore is likely to give better results than a hard, dense ore, even though the latter is higher in available oxygen. In a dense ore, the depolarizing reaction takes place only on the surface, while in a porous ore it is able to occur throughout the mass. Better service life is obtained from a dry cell containing rather coarsely ground ore which is able to hold more electrolyte than finely ground ore. Other factors of importance are the porosity of the ore and the fact that more contact resistance exists between the particles of fine ore than those of coarse ore. It has also been demonstrated that careful grading of the ore greatly influences the performance of a cell. The ore, therefore, should not be of an earthy nature like wad, as this mineral does not lend itself to efficient milling and grading.

Prior to the war, the manganese ore used in dry cell manufacture was Caucasian pyrolusite. The common method of specification was for material containing from 80 to 85 per cent MnO_2 and less than 1 per cent iron. No particular attention was given to other ingredients, at least by most buyers, because of the purity and uniformity of the Caucasian ore. There are considerations other than the content of MnO_2 which determine the usefulness of manganese for depolarizer purposes, such as the screen analysis, hardness, density and other physical qualities. Various manufacturers employ different specifications as to the screen analysis, a common specification being that the run of material shall pass through a 10-mesh or a 20-mesh screen. Some manufacturers specify the removal of the fine particles.

During the war manganese from many other sources was used in the dry-cell trade owing to the scarcity of the Caucasian material. Most of these ores run lower in MnO_2 and higher in iron and they have larger percentages of impurities, some of which are decidedly harmful. During the war, users accepted material that ran from 70 to 80 per cent MnO_2 and as high as 3 to 4 per cent in iron. Users have found by experimental work and manipulation how to get results with domestic ores and with foreign ores other than Caucasian, closely approximating the results secured from Caucasian material.

An important source of manganese dioxide during the period of great scarcity during the war was the ore obtained from old dry cells, which was rejuvenated by processes generally kept secret by the firms employing them. Such processes doubtless contributed

[1] Storey, O. W., "Determination of Manganese Dioxide in Pyrolusite," C. F. Burgess Laboratories, Madison, Wis.

in an important degree to the conservation of our high-grade domestic manganese ore.

In the manufacture of dry cells, two classes may be recognized—the standard or so-called No. 6 cell, which is used for ignition, telephone, signal and other similar purposes; and the small-size, or flashlight type, which is used for portable lighting. The quantity of pyrolusite ores used in the standard No. 6 cell is far larger than that used in other sizes. In the flashlight business, which is growing with great rapidity, the higher grades of materials are required, such as 80 to 85 per cent ore which has been purified and also various grades of chemically prepared manganese dioxide and hydrates of the same.

Manganese Ore in the Ceramic Industries

Use in Making Glass

Practically all the raw materials used in glass contain some iron, usually in the form of ferric oxide. The iron, when present even in small quantity, imparts to the glass a pale green color which increases rapidly in intensity as the iron content increases. If a colorless glass is desired, this green color must be removed, removal being effected by the use of various decolorizers. Manganese, selenium, cobalt and nickel are the most common decolorizers in use, and of these four, manganese has been most commonly employed because it permits easy control of the color. In using selenium and nickel, the quantity must be carefully controlled, but these latter substances are desirable, especially in window and plate glass, because glass decolorized with manganese often changes to a pink color on exposure to the light. A decreasing quantity of manganese is being used by makers of tank glass, and its place is being taken by selenium.

The quantity of manganese used varies considerably, depending on the character of the glass, the method of its manufacture, the iron content of the raw materials and the character of the manganese ore used. Each manufacturer has his own ideas on this subject and he puts these into practice within certain limitations. The quantity used is figured in terms of pounds of manganese dioxide per 1000 lb. of sand, which constitutes 50 to 75 per cent by weight of the entire batch. The temperature employed in the glass-making process is also a factor determining the quantity of manganese dioxide used; the higher the temperature employed, the more manganese is necessary owing to the volatilization. The maximum limit is 10 to 15 lb. of manganese dioxide per 1000 lb. of sand, from which it may range to as low as 2 to 2½ lb. of manganese dioxide.

Chemistry of Use of Manganese in Glass Making Process

The compounds of manganese, when other coloring ingredients are absent, produce pink, purple and violet hues according to the chemical nature of the glass. The presence of manganese dioxide neutralizes the green color due to the presence of iron compounds in the raw materials. Used in excess, it imparts an amethyst tint, and when used in considerable excess, the color is so intense as to appear black.

The neutralization of the iron tint by manganese dioxide is explained by some chemists on physical grounds, and by others on a purely chemical basis. The green tint is due to the presence of ferrous silicate. It is thought by some that this green compound is oxidized to the ferric silicate, the color of which is an almost imperceptible pale straw yellow. According to this view, the oxidizing agent used must not completely decompose at high temperatures, and manganese dioxide appears to be the most available compound fulfilling this condition. At red heat, the dioxide loses one-third of its oxygen, leaving the tetra-oxide (Mn_3O_4) which, at still higher temperatures, is an oxidizing agent.

Red lead and other oxidizing agents have not this decolorizing power, which has given basis to the thought that the result is not due to oxidation, or chemical reaction, but that the phenomenon is purely physical in its nature. It is possible, however, that other compounds may lose their oxygen at too low temperatures to be effective as oxidizing agents.

Specifications for Manganese Ore Used in Making Glass

Before the war, the ordinary specifications for manganese ore used in glass making were 85 to 90 per cent manganese dioxide and less than 1 per cent metallic iron. Outside of these two ingredients, each manufacturer has his own peculiar requirements. Special glasses may require a grade of ore carrying more than 90 per cent manganese dioxide and less than 0.5 per cent iron. The higher the manganese content and the lower the iron, the better the material for glass-making purposes. In general, the grades of ore used in this industry are similar to the grades used in the dry cell industry. Obviously, siliceous pyrolusite is not objectionable, but carbonaceous pyrolusite is.

The manganese ore for use in glass is sold in powdered, granulated or lump form. There are certain objections to the lump form, owing to the time required to melt it into the batch. The powdered ore is used principally where the glass is made in pots. The lump ore, or granular, is used when melting is done in tanks.

Before the war, high-grade pyrolusite for glass making and other chemical purposes was imported from Russia, Saxony, Japan, Nova Scotia, and other foreign countries. As the war progressed, it became difficult to obtain foreign high-grade ore and, as a consequence, specifications were relaxed and low-grade ores were offered and purchased. During the war period some excellent domestic ore was developed, which found a ready market.

Other Ceramic Uses

Another use for manganese ore in the glass-making industry has developed in the last few years, namely, in the production of black glass used for ornamental purposes. About 3 per cent of ore is added to the batch in making this opaque glass. Pyrolusite is also added to the constituents of glazes and enamels to produce purple tints. Black enamels are those containing manganese. Manganese oxide is also used in brick making.

Use of Manganese Salts in Driers

Definition. Driers are those substances, generally metallic oxides or their compounds, which are added to linseed or other drying oils at high or low temperatures to make them capable of readily absorbing oxygen from the air, or of drying by its action. The action is considered by some chemists to be catalytic, the manganese compound acting as a catalyzer or carrier of oxygen. The principal manganese compounds used as driers are: Manganese sesquioxide (Mn_2O_3), pyrolusite (MnO_2), also known in the trade as dioxide, binoxide or peroxide.

manganese hydrate, sulphate, borate, resinate, linoleate, oxalate and possibly other salts. Certain corresponding double salts of manganese and lead are often used.

Some persons claim that pyrolusite is now little used in driers because the manufactured hydrate, on account of its purity, gives better results. This claim does not agree with statements made by dealers in the trade. Of the various substances named above, each acts in a way peculiar to itself. These driers are added only in small quantities, usually less than 0.5 per cent.

Manganese Dioxide. Manganese dioxide is extensively used as a drier. It comes onto the market in two forms, the natural and artificial. The natural mineral, pyrolusite, is simply ground to a powder with water and then dried. The mineral is essentially a peroxide, a class of substances containing more oxygen than is required to satisfy the valence of the metal present. This extra oxygen is loosely combined and readily enters into combination with oxidizable bodies. This feature in the composition of manganese compounds makes them useful in oil boiling, for the oxygen during this process combines with the oil, oxidizing it, while the manganese dissolves to some extent in the oil in the form of a compound with the linoleic acid of the oil. In consequence of this action manganese compounds are powerful driers. The quantity of manganese dioxide added in the process of boiling is small, not more than ¼ lb. to a hundredweight of oil to get the best results. The use of the black dioxide, however, tends to make the oil dark.

Manganese Sulphate. The methods of preparing this compound and its uses are described later. Rather less than ½ lb. is added to each hundredweight of oil or paint. It is largely used by oil boilers as a drier of pale boiled oils.

Manganese Borate. Manganese borate is perhaps the least objectionable of all the manganese salts used as drying agents, though the black oxides are more largely used. To make the borate, 1 part of manganese sulphate is dissolved in 10 parts of distilled water and a little of this is added to some soda solution to determine whether any iron is present. If pure, the manganese sulphate solution is added to the hot borax solution as long as a precipitate forms. The precipitate is filtered, washed with hot water, and dried.

Manganese Resinate. Resinates, formed by the combination of resin or rosin with certain metallic oxides, occupy a prominent position in modern varnish and paint making and with the exception of the linoleates are most readily soluble in linseed oil. The manganese resinate is made as follows: Soda ash is dissolved in water and the solution is boiled with steam, and light coarsely powdered rosin is added. After the proper quantity of rosin has been added, more soda ash is added. The clear solution is allowed to run into a clear manganese chloride, the resinate separating as a white flocculent precipitate. This is filtered, washed and dried.

Manganese Linoleate. This is made by pouring a solution of a soap, made by boiling linseed oil and caustic soda, into a solution of manganese chloride or manganese sulphate. It forms a dark-brown plaster-like mass, liable to oxidation. When exposed to air, the surface becomes covered with a hard rather insoluble protective skin. The material should, therefore, be kept in tightly closed vessels. It acts both as a bleaching agent and a drier on linseed oil. One pound mixed first with 5 lb. of linseed oil and the whole poured into 10 gal. of linseed oil at 250 deg. F. gives a good drying oil.

Manganese Oxalate. This salt is prepared by precipitating manganese salts with oxalate of soda or potash or by treating manganese hydrate or carbonate with oxalic acid. One of its advantages is said to be that during the process of oil boiling it is decomposed, the manganese dissolving in the oil in combination with linolelc acid, while the oxalic acid is decomposed and evolved in the form of carbonic acid. One-fourth to one-half a pound may be used per hundredweight of oil.

Use of Manganese in Miscellaneous Chemicals

Manganese Chloride. Manganese chloride ($MnCl_2$) is prepared by the action of hydrochloric acid on the dioxide. Chlorine is a by-product of this reaction. It is a rose red, deliquescent salt used in dyeing cotton cloth a manganese brown or bronze. The fabric to be dyed is soaked in the salt solution and passed through a caustic alkali, whereby manganese hydroxide is precipitated in the fabric and on subsequent oxidation, turns brown. The material thus treated may also be used for subsequent dyeing by aniline black.

Manganese Sulphate. This salt ($MnSO_4$) may be prepared on a large scale from the black dioxide by heating to redness with ferrous sulphate and by subsequent extraction with water. It forms pink crystals which are readily soluble in water and are used in calico printing and in porcelain painting. It is also used at drier for pale oils or for conversion into the oxalate or borate which are used for the same purpose.

Manganese Persulphate. This salt, $Mn(SO_4)_2$, is prepared by the electrolytic oxidation of manganous sulphate ($MnSO_4$) and forms a black substance which can only be obtained in solution in the presence of sulphuric acid. It has marked oxidizing properties and is used as an oxidizing agent in making organic products.

Potassium Permanganate. This substance ($KMnO_4$) is prepared industrially by mixing a solution of caustic potash (KOH), specific gravity 1.44, with powdered manganese dioxide and an oxidizing agent like potassium chlorate. The whole is boiled and evaporated, and the residue is fused in crucibles and heated until it acquires a pasty consistency. The potassium manganate (K_2MnO_4) thus obtained is dissolved by boiling with much water while a current of chlorine, carbon dioxide or ozone is passed through the liquid. The potassium permanganate separates in crystalline form from concentrated solutions even in the presence of the caustic potash formed during the reaction, and is separated from the dissolved substances in a hydro-extractor.

The permanganate is used for conserving wood; it is also used for bleaching textile fibers, by immersing them for a time in an aqueous solution of the permanganate and then dissolving the manganese dioxide with sodium bisulphite. The permanganate is an energetic disinfecting and oxidizing agent and is used for purifying various gases.

Chemical Glassware

The manufacturers of chemical glassware in this country fear that the importation of the Japanese laboratory glassware will greatly endanger the American industry. It is claimed that labor alone costs in this country nearly equal the selling price of the Japanese goods. A committee of chemical glassware and porcelain manufacturers has urged the Ways and Means Committee of Congress to levy a 60 per cent *ad valorem* tariff on imports.

Exports and Imports

The Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce reports for May, 1919:

DOMESTIC EXPORTS OF CAUSTIC SODA AND SODA ASH FROM U. S.

Countries	Caustic Soda — Lb.	Caustic Soda — Value	Soda Ash — Lb.	Soda Ash — Value
Denmark	113,270	$5,520	.....	.....
France	400	120	.....	.....
Greece	217,597	6,498	.....	.....
Iceland and Faroe Islands	9,350	193	1,200	$26
Norway	247,868	14,857	76,800	1,814
Spain	218,220	9,710	.....	.....
Sweden	22,450	710	.....	.....
Bermuda	582	12	.....	.....
Canada	547,346	23,904	4,897,753	104,546
Costa Rica	8,100	256	.....	.....
Guatemala	4,000	153	.....	.....
Nicaragua	15,201	685	4,875	122
Panama	11,215	380	9,000	180
Salvador	605	73	2,272	55
Mexico	939,572	32,842	141,278	3,934
Newfoundland and Labrador	100	20	.....	.....
Jamaica	546	32	3,000	120
Cuba	282,996	9,102	128,058	2,442
Dominican Republic	2,040	96	1,050	34
Argentina	315,059	16,907	.....	.....
Brazil	1,081,387	46,891	183,165	6,078
Chile	298,510	11,417	44,960	1,592
Colombia	138,650	4,037	13,500	321
Ecuador	6,750	180	492	18
Peru	209,500	9,705	30,000	750
Uruguay	112,000	3,360	.....	.....
Venezuela	34,225	1,549	2,100	47
China	748,760	28,016	21,792	489
Japanese China	88,450	6,191	.....	.....
Chosen	120,330	4,633	.....	.....
British India	135,282	4,618	.....	.....
Other British East Indies	22,400	731	300	15
Dutch East Indies	123,200	3,460	22,608	559
Hongkong	151,435	5,400	.....	.....
Japan	1,500,885	56,637	148,539	5,110
Australia	.....	.....	1,568,020	76,420
New Zealand	1,700	84	.....	.....
French Oceania	1,968	67	.....	.....
Philippine Islands	74,640	2,084	.....	.....
British South Africa	42,650	1,316	.....	.....
British East Africa	22,400	685	.....	.....
Total	7,871,639	$313,131	7,300,762	$204,672

IMPORTS OF TUNGSTEN-BEARING ORE INTO THE U. S. BY COUNTRIES—EXPORTS OF TUNGSTEN-BEARING ORE AND FERROTUNGSTEN METAL FROM THE U. S.

Imports: Countries	Tungsten-Bearing Ore, Tons	Tungsten-Bearing Ore, Value	Exports: Countries	Tungsten and Ferrotungsten, Lb.	Tungsten and Ferrotungsten, Value
Mexico	4	$2,614	Brazil	49	$129
Chile	1	1,661			
Peru	26	26,500			
China	53	35,178			
Straits Settlements	50	44,688			
Hongkong	151	144,658			
Total	285	$255,299			

IMPORTS OF LEAD AND ZINC INTO THE U. S. BY COUNTRIES—DOMESTIC EXPORTS FROM THE U. S. (TOTALS ONLY)

Articles and Countries	Imports Gross Weight, Tons	Imports Contents, Lb.	Imports Value
Lead Ore			
Canada	715	801,786	$28,916
Mexico	1,300	256,600	11,614
Chile	2,457	1,507,004	45,210
Total	4,472	2,565,390	$85,740
Lead Bullion and Base Bullion			
Mexico	6,831,268	6,683,731	$272,356
Lead Pigs, Bars and Old			
Panama	.....	5,040	$162
Mexico	.....	400	20
Total	.....	5,440	$182
Zinc Ore and Calamine			
Canada	103	77,000	$1,375
Mexico	672	507,619	6,534
Total	775	584,619	$7,909
Zinc Blocks or Pigs and Old			
Canada	.....	64,176	$2,246
Cuba	.....	2,722	54
Total	.....	66,898	$2,300
Zinc Dust			
Canada	.....	18,262	$367

Domestic Exports	Lb.	Value
Lead pigs (domestic ore)	372,510	$23,684
Lead pigs (foreign ore)	1,905,041	100,801
Zinc spelter (domestic ore)	11,076,264	910,311
Zinc spelter (foreign ore)	176,000	12,320
Zinc in sheets	1,336,244	164,420

IMPORTS INTO AND EXPORTS FROM THE U. S. OF PLATINUM IRIDIUM, ETC., BY COUNTRIES

Countries	Imports: Iridium, Osmium, Palladium, etc., and Native Combinations Thereof with Platinum, etc. Oz., Troy	Imports: Iridium, Osmium, Palladium, etc., and Native Combinations Thereof with Platinum, etc. Value	Imports: Platinum Unmanufactured Oz., Troy	Imports: Platinum Unmanufactured Value
France	2,045	$122,830	3,368	$322,486
England	123	23,622	16	1,568
Canada	134	14,988	13	1,227
Colombia	.....	.....	3,878	321,039
Peru	.....	.....	12	961
Uruguay	.....	.....	4	420
Australia	77	8,337	.....	.....
Total	2,379	$169,777	7,291	$647,701

Exports: Countries	Platinum Unmanufactured Oz., Troy	Platinum Unmanufactured Value	Manufactures of Value
Spain	...	.....	$200
Canada	38	$4,066	2,014
Mexico	...	.....	2
British India	...	.....	382
Dutch East Indies	...	.....	410
Japan	...	.....	115
Philippine Islands	...	.....	65
Total	38	$4,066	$3,188

DOMESTIC EXPORTS OF MINING MACHINERY FROM THE U. S. TO ALL COUNTRIES

Countries	Oil Well Machinery Value	All Other Mining Machinery Value	Countries	Oil Well Machinery Value	All Other Mining Machinery Value
France	$1,313	$98,131	Peru	$1,810	$21,792
Italy	.....	10,580	Venezuela	34,966	700
Norway	.....	2,450	China	.....	436
Spain	.....	4,500	Chosen	.....	532
Switzerland	191	.....	British India	3,757	56,355
England	5,338	33,630	Dutch East Indies	40,520	6,303
Canada	57,306	57,310	Hongkong	.....	151
Costa Rica	26,023	2,339	Japan	1,075	27,441
Honduras	.....	2,168	Russia in Asia	.....	750
Nicaragua	.....	3,596	Australia	.....	19,925
Panama	.....	48	Philippine Islands	.....	315
Salvador	.....	344	Belgian Kongo	8,845	160,279
Mexico	33,344	126,932	British West Africa	.....	8,759
Newfoundland and Labrador	.....	2,941	British South Africa	.....	154,710
Trinidad and Tobago	150	.....	French Africa	7,255	14,170
Cuba	2,996	32,685	Portuguese Africa	.....	33,224
Argentina	6,451	.....			
Bolivia	197	.....			
Brazil	.....	1,725			
Chile	.....	22,099			
Colombia	.....	3,512	Total	$233,783	$910,832
British Guiana	2,246	.....			

Consumption of Tungsten in 1918

An interesting summary of the consumption of tungsten in 1918 based on questionnaires distributed by the Bureau of Mines shows that the tungsten used in the making of tungsten powder, ferro and acid, from May to December, 1918, amounted to about 7,500,000 lb., from which it is estimated that the total tungsten used in such products for the calendar year 1918 amounted to about 10,000,000 lb. and that the amount of tungsten used in making malleable products during the same time was approximately 210,000 lb.

The quantity of high-speed steel made from May to December, 1918, was nearly 30,000,000 lb., from which it is estimated that the total weight of such steel in the year was somewhat in excess of 40,000,000 lb.; the tungsten content was probably nearly 7,000,000 lb. The tungsten steel made from May to December, 1918, was in excess of 45,000,000 lb., from which it is estimated that the total quantity produced in 1918 was approximately 62,000,000 lb.

The amount of 60 per cent concentrates required to make the tungsten powder, ferro and acid used in 1918 was approximately 13,000 tons, assuming that 1 ton of 60 per cent concentrates is reduced to 760 lb. of contained tungsten in ferro.

The accompanying diagram of manufacture of tungsten products gives a comprehensive survey of this field.

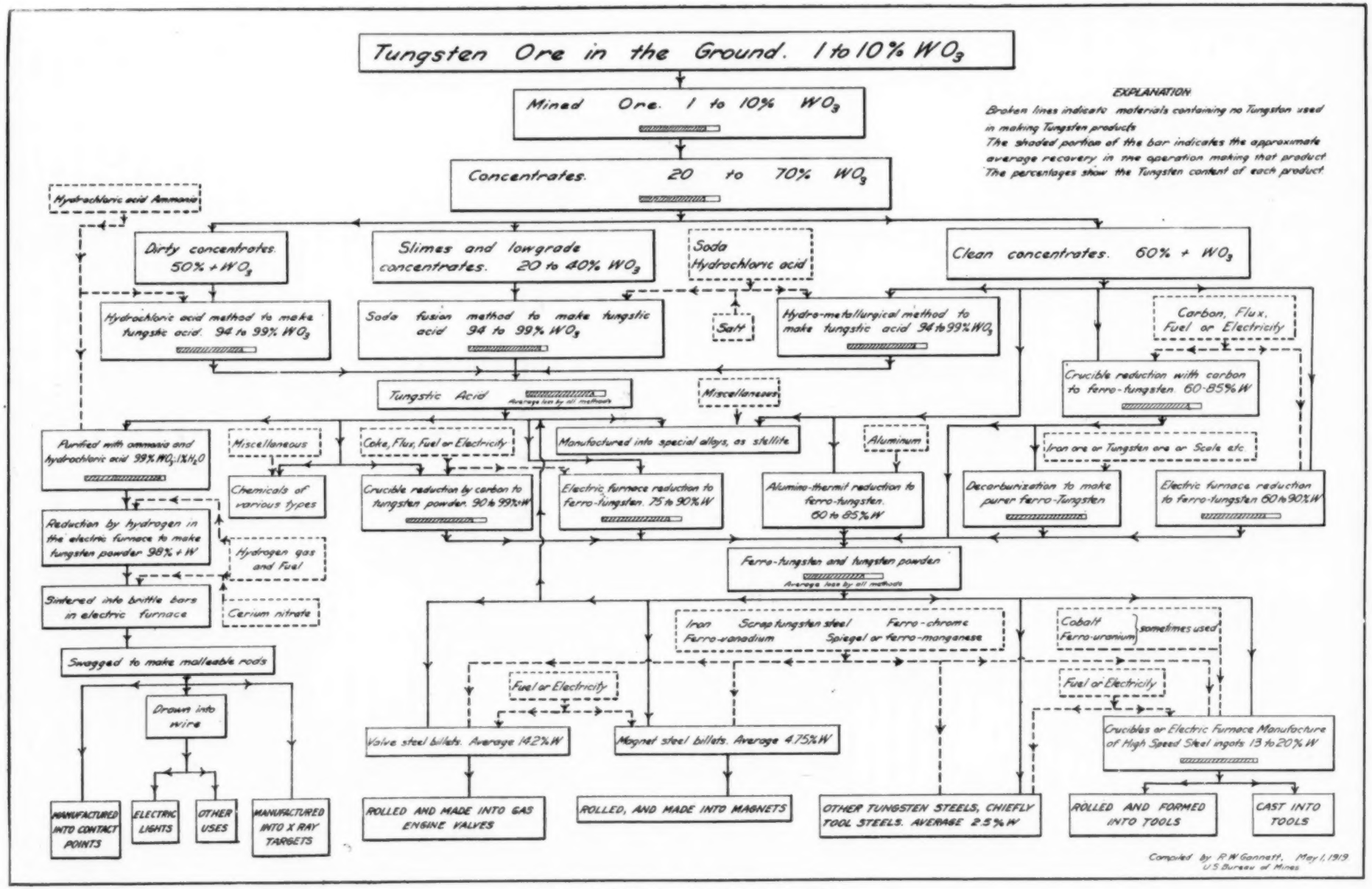

Tungsten Ore in the Ground. 1 to 10% WO_3
Mined Ore. 1 to 10% WO_3
Concentrates. 20 to 70% WO_3
EXPLANATION
Broken lines indicate materials containing no Tungsten used in making Tungsten products
The shaded portion of the bar indicates the approximate average recovery in the operation making that product
The percentages show the Tungsten content of each product
Hydrochloric acid Ammonia
Dirty concentrates. 50% + WO_3
Slimes and lowgrade concentrates. 20 to 40% WO_3
Soda Hydrochloric acid
Clean concentrates. 60% + WO_3
Hydrochloric acid method to make tungstic acid. 94 to 99% WO_3
Soda fusion method to make tungstic acid 94 to 99% WO_3
Salt
Hydro-metallurgical method to make tungstic acid 94 to 99% WO_3
Carbon, Flux, Fuel or Electricity
Crucible reduction with carbon to ferro-tungsten. 60-85% W
Tungstic Acid
Average loss by all methods
Miscellaneous
Purified with ammonia and hydrochloric acid 99% WO_3 1% H_2O
Miscellaneous
Coke, Flux, Fuel or Electricity
Manufactured into special alloys, as stellite
Aluminum
Iron ore or Tungsten ore or Scale etc.
Chemicals of various types
Crucible reduction by carbon to tungsten powder. 90 to 99% W
Electric furnace reduction to ferro-tungsten. 75 to 90% W
Alumino-thermit reduction to ferro-tungsten. 60 to 85% W
Decarburization to make purer ferro-Tungsten
Electric furnace reduction to ferro-tungsten 60 to 90% W
Reduction by hydrogen in the electric furnace to make tungsten powder 98% + W
Hydrogen gas and Fuel
Ferro-tungsten and tungsten powder
Average loss by all methods
Sintered into brittle bars in electric furnace
Cerium nitrate
Iron Scrap tungsten steel Ferro-chrome Ferro-vanadium Spiegel or ferro-manganese
Cobalt Ferro-uranium } sometimes used
Swaged to make malleable rods
Fuel or Electricity
Fuel or Electricity
Drawn into wire
Crucibles or Electric Furnace Manufacture of High Speed Steel ingots 13 to 20% W
Valve steel billets. Average 14.2% W
Magnet steel billets. Average 4.75% W
MANUFACTURED INTO CONTACT POINTS
ELECTRIC LIGHTS
OTHER USES
MANUFACTURED INTO X RAY TARGETS
ROLLED AND MADE INTO GAS ENGINE VALVES
ROLLED, AND MADE INTO MAGNETS
OTHER TUNGSTEN STEELS, CHIEFLY TOOL STEELS. AVERAGE 2.5% W
ROLLED AND FORMED INTO TOOLS
CAST INTO TOOLS
Compiled by P. W. Gannett, May 1, 1919
U.S. Bureau of Mines

CHART SHOWING USES OF TUNGSTEN

Growth of the Kelp Organism

By J. W. Turrentine

EARLY surveys of the areas of growing kelp, made by the Bureau of Soils from the Santa Cruz Islands, on the coast of Lower California, to the Peninsula of Western Alaska, showed in the aggregate such enormous quantities of kelp available that it appeared that here was the source of potash which might be developed into an important industry. The early surveys had little reference to the accessibility of the growing kelp or to the feasibility of harvesting it for fertilizer purposes, since at that time, of course, no plants had been constructed for the treatment of kelp, and it was not possible to bring to bear any information obtained in actual experience. Now for several years kelp potash plants have been in operation, and we are beginning to know how to estimate with some reliability the quantities of potash that can be obtained from kelp in actual commercial operations; and while these quantities are relatively small as compared with the total quantities existing as growing kelp, they are still large enough to warrant us in the belief that it will be possible to establish a kelp potash industry that for normal times will be both permanent and important.

To furnish the annual tonnage recently cut in California with certainty (400,000 to 500,000 tons), practically the entire areas of growing kelp of southern California and the islands contiguous thereto from Point Conception southward have been required. It is entirely possible that, after greater experience in the gleaning of kelp and the conservation of the kelp beds, these areas can be made to furnish considerably more than this. At present the kelp beds are yielding three or four crops of kelp per year.

Proper Harvesting Procedure

To obtain the maximum yields, the same procedure should be observed with regard to harvesting kelp that is observed with regard to harvesting any agricultural crop that is a perennial and renews itself promptly after harvesting. That is to say, sufficient time should be permitted to elapse for the growth to renew itself fully, otherwise only an imperfect yield is obtained. Now control of the kelp beds of California lies in the hands of the State Fish and Game Commission, who declare harvested areas closed to harvesters until the growth has renewed itself completely. This undoubtedly will result in a larger yield of kelp from each bed.

But with all this, a liberal margin must be allowed over the actual tonnage required to provide against unavoidable contingencies such as the destruction of a portion of the beds by storms or by disease, as happened during the summer of 1918 in some of the large beds in the Santa Barbara region. At the same time it is within the realm of possibility that areas of growing kelp can be enlarged by kelp farms, and that increased economy in harvesting, a larger number of crops per annum, and great improvements in the technology of the industry may all combine to bring about an enlargement of the industry here. And, besides, there are large areas of kelp on Puget Sound and in Alaska which to date are practically untouched, certainly some, and perhaps all, of which can be made to yield their quota of potash.

The kelp making up the beds of southern California is known botanically as Macrocystis pyrifera, and grows in about 75 ft. of water. Its place of growth is determined by a suitable bottom whereon it can secure anchorage, and tideways or surf to keep it supplied with fresh volumes of water from which it obtains its sustenance. It is held upright in the water by small air bulbs, pneumatocysts, one at the base of each leaf, which keep it pulled upward toward the light; and on reaching the surface it continues to grow, spreading out on the surface in large tangled mats. Its total length is probably from 100 to 150 ft.

How Kelp Is Gathered

With the cutting knives lowered into the water and cutting at depth of 6 ft., the harvester is forced through this mat of growing material and cuts it loose in quantities, dragging it on board by means of an apparatus similar to the familiar reaper of the grain harvester. It is then properly stored by means of a distributer operated mechanically, the entire apparatus making possible the harvesting of some 30 tons per hr., with a total crew of not more than five men, one in the engine room, one in the pilot house, one to man the cutter and its engine, and two to distribute the load. By this simple mechanism it is possible to handle tremendous quantities of material, and the problem of harvesting would be very simple indeed, if it were not for the long hauls occasioned at times by the distance of plants from the kelp beds, and the seasons of storms which interfere with harvesting.

The opinion has been expressed by operators of kelp harvesters that the kelp after having been harvested comes back in thicker growths, from which it has been concluded that there is a sort of stooling effect as in the case of alfalfa or wheat. The lack of definite knowledge as to what actually takes place at the bottom of the ocean, 75 ft. below the surface, makes it impossible to say whether this is a true statement of what actually takes place or not. But at least it is indicative of the completeness with which the kelp beds restore themselves after being cut over. It appears probable that when the growing tip on the end of a strand of kelp is cut off, that strand dies back to the bottom, and that the prompt regrowth is the result of what might be termed as undergrowth of shorter kelp shoots which spring to the surface promptly when the sunlight is admitted to them through the removal of the dense mass of kelp lying on the surface. When the so-called kelp roots, or, more properly, hold-fasts, are washed ashore, it is seen that there has been an actual branching; and it is quite possible that branching at the bottom is induced by cutting off the surface growth.

Investigations in Progress

Investigations are now in progress touching on all of these questions. They are purely biological and may be termed mariculture. Some day we may have developed a definite science, or a science as definite as that of agriculture, pertaining to the growing of such things in the sea. Of course, the cultivation of seaweeds is an old-established industry of Japan. There the developments within the past few years, or since the Russo-Japanese war, have resulted in the establishment of a kelp potash industry which has made possible the production of potash and iodine there in quantities adequate to supply domestic needs in these two commodities and to make possible their exportation in certain quantities.

This is astonishing, indeed, when we remember that the kelp there dealt with grows at the bottom of the ocean and is only a few feet in length. It is gathered

at a depth of some 15 ft. almost altogether by woman divers, who go overboard with a knife, gather a bunch in their arms, cut it off, and come back to the surface with the bundle. If this can be done by the Japanese, it is evident that by the exercise of the proper science and economy we in this country, who have kelp growing in such a manner that it can be harvested in hundred ton lots by machinery, can likewise establish an industry of importance and value.

Fibrous Structure in High Carbon Steel

By A. W. Lorenz

MUCH discussion has been aroused recently regarding the cause of the so-called "fibrous" or "woody" structure in high carbon and nickel steel forgings. This trouble seems to have manifested itself strongly in the manufacture of ordnance material. In this connection the writer wishes to present some interesting facts and data in connection with one ordnance contract in particular, which may throw some light on the general question of fibrous structure.

The Specifications

The specifications required that a slab or test slice be cut from one end of the forging, which was approximately 9 ft. long and had a diameter of about 7 in. Out of this slice five transverse tests were required: Bend test A, tensile test 1, tensile test 2, tensile test 3, bend test B.

The actual test requirements need not be stated, as their consideration is unnecessary in this article. It is sufficient to state that the failure of any one of the above tests called for retreatment or rejection of the forging. Two forgings were made from one ingot, and it was the practice to cut the test slabs from the two forgings off the particular ends which represented the top and bottom of the original ingot. If a re-test was required it was then made from the end of the forging corresponding to the middle of the original ingot.

Results

A tabulation of the results from about 700 tests gave:

	Top Per Cent Good	Middle Per Cent Good	Bottom Per Cent Good
Test No. 1	92	90	96
Test No. 2	43	31	82
Test No. 3	62	71	73

It will be noticed that No. 1 test (tensile) was invariably good. The probable reason for this will be discussed later. However, the outstanding feature of the above tabulation is the greater uniformity of the three tensile tests taken from the slice representing the bottom of the ingot, and the marked superiority of the results off the bottom slice as compared with the tests from the middle and top of the ingot. In fact, this superiority became so evident that the Government, to protect itself, later ruled that all tests should be taken from the top and middle positions. This at once suggests that the trouble, which generally manifested itself by fibrous fracture, is due to impurities of some nature which slowly arose to the upper portions of the ingots while cooling, leaving the bottom relatively clean. Several heats were therefore made, using the utmost care in the control of furnace conditions looking toward the production of steel free from impurities. These heats were no better (in fact one was worse) than the average.

Accident Leads to Interesting Development

About this time an accidental oversight in the shop led to interesting developments. It was the practice to wash the ingot molds with tar in order to prevent surface cracks. On one heat this was overlooked, and the resulting forgings were 100 per cent good. This recalled to the writer the fact that the first two sample heats were also extremely good and that the only difference between these and subsequent heats was the use of clay wash instead of tar on the molds. In connection with this trend of thought it was noticed, while pouring several heats of metal into tar-washed molds without the addition of aluminum, that the metal boiled out until a cone over a foot high was formed at the top of the ingot, whereas with clay or graphite washed molds, the metal remained quiet.

Now it seems to the writer that the tar, in distilling, filled the otherwise good metal with gas which worked its way to the upper portion of the ingot, there to be entrapped by the freezing metal. This accounts for the superiority of the tests from the bottom end of the ingot. On forging, these blow-holes were forged out but not welded shut and consequently hairline cracks were developed which would have little effect on a longitudinal test but were quite detrimental to transverse tests. Of course slag and solid impurities would act in the same way, but microscopic and macroscopic examination of the fracture would disclose the presence of slag. Slag was certainly present, but not in undue amounts, and no more so in bad than in good samples. Moreover, oxidizing slag would be evidenced by a decarbonized zone under microscopic examination, and in the fracture itself perhaps by a discoloration.

This was not the case with the failures in question. A gray fibrous structure was evident in the fracture usually, and in well marked samples the break seemed worn with a smooth, silvery appearance usually associated with the inside of a blow-hole that has not been exposed to oxidation. Examination of unetched samples showed, under a magnification of 100, the presence of numerous pin-holes, so small as to be quite invisible at 100 magnifications after etching for grain structure. On treating the unetched samples with iodine, these small pin-holes gradually developed into cracks about $\frac{1}{8}$ in. long in the direction of forging. Etching with hot sulphuric acid developed this structure still more strongly, showing cracks sometimes $\frac{1}{4}$ in. in length.

Theory as to the Nature of the Defect and What May Be Its Cause

As a general rule slag inclusions should possess a more appreciable thickness than was shown in the specimens mentioned above. The nature of the defect, therefore, seems to be a fine crack of no appreciable thickness, resulting as stated before from the squeezing shut of a blow-hole without actually welding it together. It will be noted in this respect that tensile tests No. 1 were invariably good, which may be explained by the fact that this test was in the region of greatest pressure during working under the press, and the blow-holes at this point may have been welded together to some extent. It may be stated that the forgings, being

irregular in cross-section, were formed in a die, so that the pressure was always applied over test No. 1. On the other hand, the middle tests were responsible for the greatest number of failures and it is easy to believe that the center of the forging did not receive sufficient work to weld the holes at this point. On making a macroscopic examination of a slice adjacent to a test slice, after etching with hot sulphuric acid for about half an hour, it was found that whenever the center of the slab was sound, the central test would pass specifications, and when the center was badly pitted, the test would fail.

Change in Mold Wash

Fourteen heats were cast using graphite as a mold wash instead of tar. The results were not nearly as satisfactory as expected, but were so much superior to the results on steel from tar-washed molds as to justify the statement that gassing was the cause of the trouble. The following percentages are based on all tests (to the number of several hundred) made after the change in method of testing which called for all tests to come from the top and middle:

Percentage of sets good (all three tensile tests fine:

Graphite wash, 68 per cent.
Tar wash, 34 per cent.

	Test 1, Per Cent	Test 2, Per Cent	Test 3, Per Cent
Graphite wash (good)	100	72	95
Tar wash (good)	91	37	66

In justice to the manufacturer, it should be noted that these figures do not refer to the ultimate percentages of accepted forgings.

Effect of Addition of Aluminum

It may be stated that little or no aluminum (not more than ½ oz. per ton of steel) was added to the steel (basic open hearth) after the use of graphite wash was resorted to. It is probable that the addition of a larger amount of aluminum or other scavenger would have resulted in still more improvement, but suspension of the contract shortly after the armistice was declared prevented further experimenting along this line. The above data would seem to indicate that fibrous structure is often due to the presence of gas cavities which during working have been squeezed out to a thin streak, without, however, being completely welded.

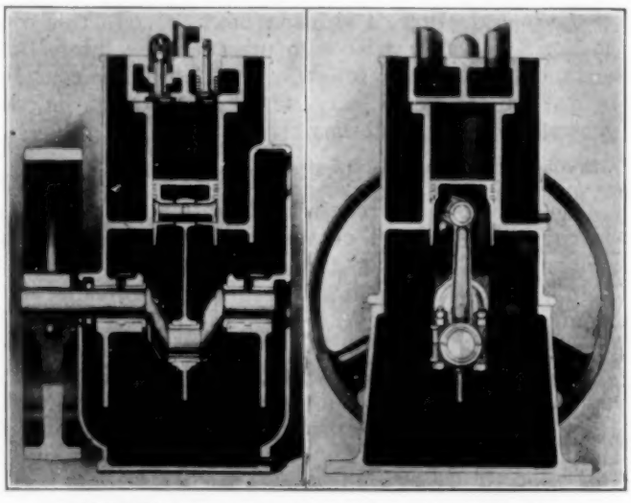
While the use of tar has been held responsible for the trouble alluded to in this particular instance, it is not the writer's intention to lay the blame for all fibrous or woody structure on the use of tar as a mold wash. It is well understood that some manufacturers may have found a way of using tar without encountering difficulty. It is also understood that any practice conducive to the formation of cavities and gas pockets will tend toward the formation of a fibrous structure during forging, provided the work is insufficient to completely weld the cavities together.

Importation of Tin

The War Trade Board Section of the Department of State will now issue licenses permitting the importation, on or after Sept. 1, 1919, of pig tin and all metal alloys containing tin, including tin drosses, tin oxides, solder drosses, type metals, anti-friction metals, waste metals and other metals containing tin, from points other than points of origin and without reference to the date of shipment.

Small Air Compressors

AT THE outbreak of the war, there was an urgent demand for a large number of small air compressors for military service where reliability was imperative. The small Imperial Fourteen type manufactured by Ingersoll-Rand had but recently been tested out. The field performance of these machines has been pronounced satisfactory and they are now being placed on the market. There are four sizes, and the capacity range runs from 3 to 45 cu.ft. per min. at pressures to 100 lb. per sq.in. The compressors can, however, be used for pressure requirements up to 200 lb. per sq.in., the horsepower needed being, of course, increased. They are single acting machines of the vertical type built for belt drive. Where driven from line shaft, tight and loose pulleys are supplied; where the use of an independent motor is planned, they are ordinarily furnished as a



ONE TYPE OF A SMALL AIR COMPRESSOR

unit complete with motor, endless belt and short drive attachment. In the latter case a hardwood base plate is included with the standard equipment.

The machines are so well balanced as to operate satisfactorily if bolted to any solid flooring, but where permanency of installation is desired the building of a concrete foundation is advocated. The smallest size is built with ribbed cylinder for air cooling where the service is intermittent and with water cooled cylinder of the reservoir type for continuous operation. Larger machines are water cooled only, employing the reservoir jacket system except that, in the case of the largest size, a closed jacket for connection to pressure system is optional. In this connection it is worth noting that the reservoir cylinder design affords unusually ample water capacity and that both cylinder barrel and head are cooled. The manufacturer states that one filling of the water space will suffice for a 10 hour day's run.

In general design these compressors remind one strongly of an automobile engine. There is the same drop forged crank shaft and connecting rod, the die cast renewable bearings, the automatic splash lubrication system and general ruggedness and simplicity which have come to be recognized as guarantees of satisfactory service under all sorts of operating conditions.

It is pointed out, however, that these little units were designed to meet exacting efficiency tests and that, while simplicity was sought, efficiency was the outstanding requirement.

Vertical-Cylindrical Electric Furnaces for Heat-Treating and Shrinking

By A. M. Clark

DEMANDS made by the United States Government during the war period for the speeding up of ordnance manufacture caused remarkable improvements in electrical furnaces, which it is predicted will have a far-reaching influence on the commercial use of industrial heating in the future.

Both the Army and Navy Departments, faced with the necessity of manufacturing guns in great quantity and at short notice, turned to the electrical engineer to help them solve their problems.

The result was the development by the General Electric Co. of a new type of electrical resistance furnace used with success in heat-treating gun forgings and in shrinking the jackets on gun barrels of large caliber.

Two forms of furnace were developed—a high-temperature resistance furnace creating a temperature of 1800 deg. F., used in tempering, hardening, and gun forgings; and a low-temperature furnace up to 950 deg. F., used primarily for shrinking jackets over gun barrels and applicable to other practices, including shrinking collars on crank shafts and rims on wheels.

This type of shrinking furnace is constructed in sections and has been built up to a depth of 88 feet. The best example is installed in the Washington Navy Yard, where guns of large caliber were built during the war. The furnace is of the vertical-cylindrical type sunk into the ground to the required depth, a section of which is shown in Fig. 1.

Its internal construction is shown in Fig. 2. Furnaces consisting of more than one section are usually equipped with a hand control which permits bringing the charge up to temperature at a uniform rate throughout the length of the furnace, the maximum temperature used being approximately 950 deg. F.

When a one-section furnace is used, it is ordinarily provided with automatic control. Furnaces of more than one section are usually hand-controlled, but automatic control can be provided. A complete one-section furnace consists of a cylindrical section, cover, base and work

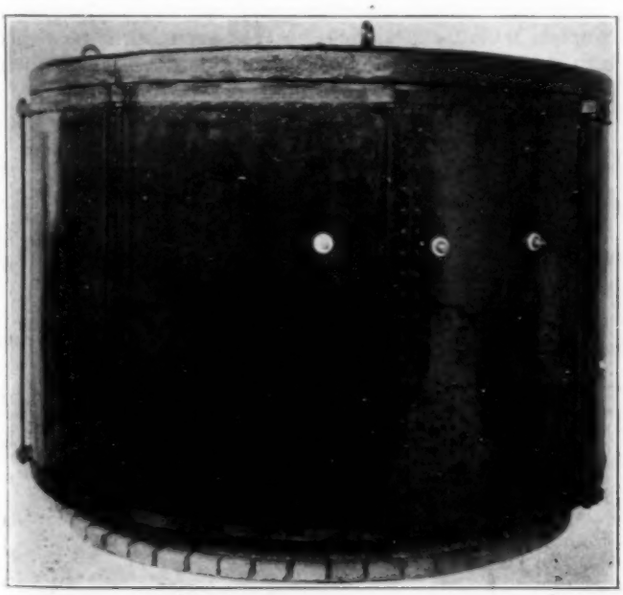


FIG. 1. SHRINKING FURNACE, ONE SECTION, WITH COVER

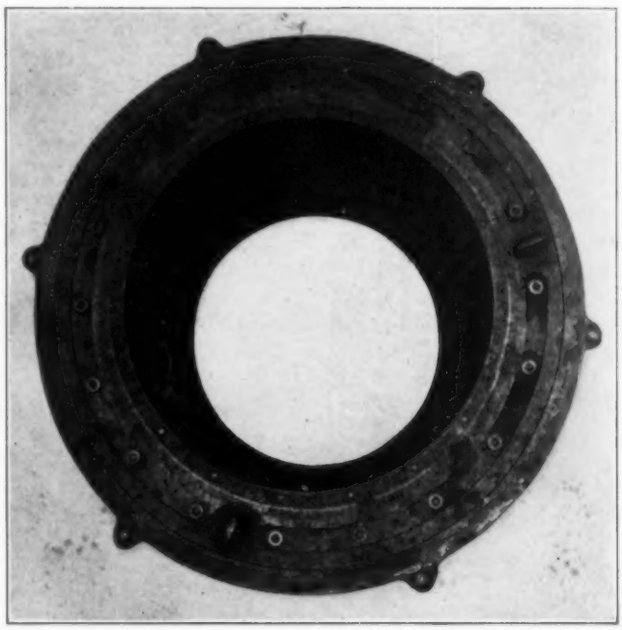


FIG. 2. INTERNAL CONSTRUCTION. DIAMETER INSIDE BORE, 4 FT.

base. The cylindrical section consists of top and bottom castings with supports, inner and outer casings enclosing the insulating material, and heating units and guards. The cast rings which form the ends of the section are recessed in such a manner that the sections can be stacked one above the other, which permits constructing a furnace of any desired height from standard sections. Provision is made for the unequal expansion of the inner and outer casings due to difference in temperatures. There is a minimum of through metal from the inner casing to the outer casing, hence the heat losses are reduced to a minimum.

The heating unit consists of a calorite ribbon mounted on a cast iron supporting plate, and insulated therefrom by suitable refractory material. A number of units are connected in series depending upon the voltage of the power supply. All connections are made with flat steel bus bars, as experience has demonstrated that the best connections can be made between flat surfaces, and steel will not oxidize at the temperatures employed in these furnaces.

The construction of the vertical-cylindrical high-temperature heat-treating furnaces involves the use of a heavy calorite ribbon supported on the inner walls of the furnace. The furnace is divided into a number of separate heating zones with an automatic temperature control for each. As indicated in Fig. 3, the walls consist of an inner lining of refractory brick and insulators backed up by a double course of heat-insulating brick and protected by a sheet metal casing. The ribbon supports and insulators are both of molded special compound laid in the lining of refractory brick with a spacing block of the same material placed between the insulators of adjacent windings, or zones. The insulators, spacers and spacing blocks are fitted at the back into a steel channel (*H*) which is in the form of a ring made up of a number of sectors tied together by bolted clamps, not shown in this figure. The spacing block (*A*) acts as a protecting buffer for the ribbon support insulators and any blow is transmitted to and distributed by the channel (*H*). An opening is provided in the spacing block (A) for the charge pyrometer tube, with a similar

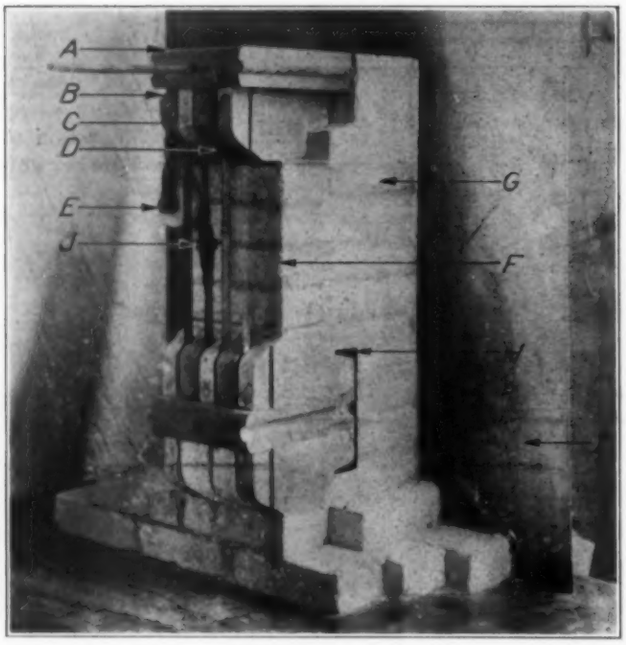


FIG. 3. SECTIONAL VIEW, SHOWING CONSTRUCTION OF WALLS AND REFRACTORIES CONVEYING HEATING RIBBONS

opening for the ribbon pyrometer in the support insulator at (*D*). The ribbon is welded to the terminal stud (*E*) and adjacent lengths of ribbon are joined by welding to the splice piece (*J*). It will be noted that the ribbon insulators are protected from mechanical injury by the spacing blocks and the shape of the former is such that any scale or dirt cannot accumulate and cause short-circuiting of the ribbon winding but will fall to the bottom of the furnace. The ribbon insulators being imbedded and forming a part of the furnace wall hold the ribbon firmly in place and eliminate the need of any form of metallic support with the inherent weakness of the latter at high temperatures. Furthermore, the omission of all metal, except through ribbon windings, in-

HEAT-TREATING GUN FORGINGS IN THE ELECTRICAL FURNACE

sures quick heating of the furnace and reduces to a minimum the waste of energy due to heat storage.

Each section is provided with a control panel, and is controlled independently of the other sections. This is accomplished by very accurate and sensitive automatic controlling instruments, one for each section, operating in conjunction with suitable relays and a contractor, so that when the temperature reaches the value for which the instrument is set, the relays and contractor are operated to disconnect the section from the power line. When the temperature has fallen only a few degrees the relays and contractors are operated in the reverse order, again connecting the section to the line. Fig. 4 shows the control instrument, and Fig. 5 shows a control

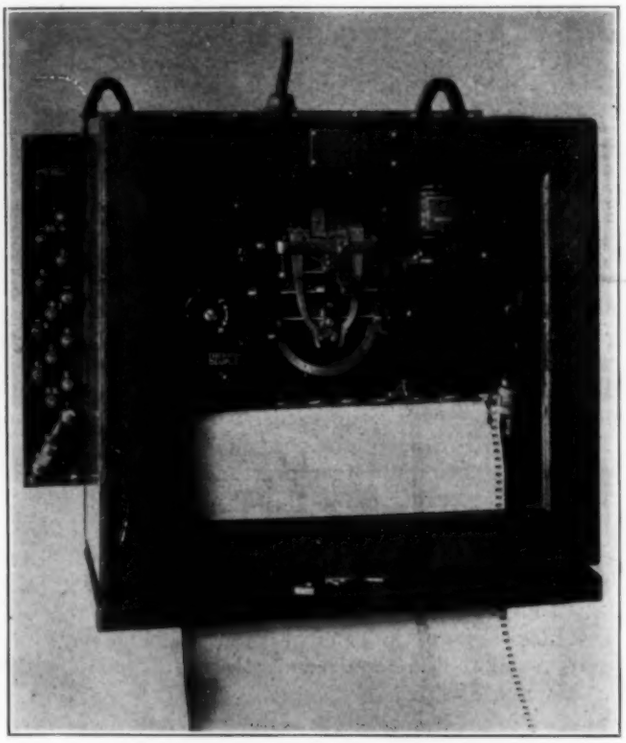


FIG. 4. TEMPERATURE RECORDER CONTROLLER FOR CONTROLLING TEMPERATURE AT TWO POINTS

board for a group of furnaces, with the instruments on the sub-base.

The instrument may be set to hold any desired temperature, and is provided with a paper roll and recording mechanism, so that indicating, recording and controlling features are all combined in a single instrument, and charts are available for record and reference.

The temperatures are measured by means of thermocouples, which experience and research have developed into exceedingly accurate and reliable devices. Two of these thermocouples are used in each furnace section, one near the resister, and the other against the charge.

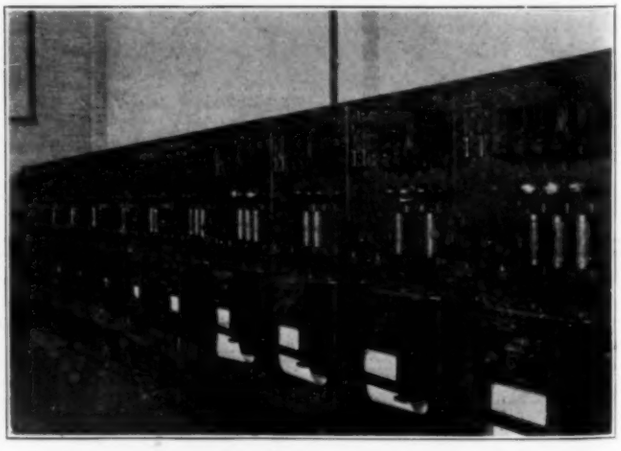


FIG. 5. AUTOMATIC PANELS AND CONTROL INSTRUMENTS

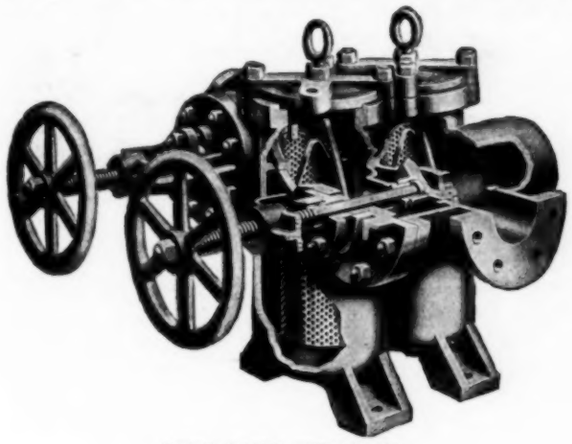
Probably the largest installation of this apparatus is in the plant of the Tioga Steel & Iron Co. of Philadelphia, Pa., a concern taken over by the Government for the war and engaged almost wholly in naval ordnance activity.

With cessation of hostilities and the practical abandoment of munition work, engineers are turning their attention to the use to which these furnaces can be put in industrial work. There are a large number of heat-treating processes in the manufacturing industries requiring temperatures from 900 to 1800 deg. F. Chief among these may be mentioned drawing and annealing carbon steels, drawing high-speed steels, annealing brass and copper, and baking vitreous enamels. The disadvantages of electrically-heated furnaces constructed and equipped with heating units and temperature-control systems as described are automatic control of the temperature, minimum temperature variation in the furnace, maximum rate of heating the charge, uniform heating throughout the charge, maximum efficiency in heat treating, elimination of scale due to oxidation, duplicate results day after day, and elimination of combustion methods with their attendant uncertainty of results and general fuel problems.

Industrial Heating Department,
General Electric Co.,
Schenectady, N. Y.

Pipe Line Strainer

The G.R. duplex strainer has been especially designed for installation in the suction or discharge lines of lubricating or fuel oil systems for the removal of solid foreign material in suspension. Such foreign material, if not removed, makes the lubrication inefficient and may seriously damage bearing surfaces. Similarly, sediment in fuel oil tends to clog the burners, reducing their capacity and necessitating frequent cleaning.



PIPE LINE STRAINER

This strainer is also suitable for straining the water supply from such sources as rivers and lakes to prevent weeds, sticks, marine plants and small fish from entering the pipe lines.

The strainer consists of a cast-iron body containing two perforated steel or brass baskets. The valve arrangement permits of the complete removal and cleaning of either basket while the other remains in service.

In operation the oil or other liquid enters the inlet connection of the strainer and passes into whichever basket is in service. The solid matter remains in the basket, the clean liquid passing through the perforations and thence out of the strainer.

All cast-iron sections are cylindrical, resulting in maximum strength. The valve mechanism is very simple and the valves are easily re-ground. This apparatus is described in Bulletin 1150 published by the manufacurer, the Griscom-Russell Co., 90 West St., New York City.

Sixty-Inch Gyratory Crusher

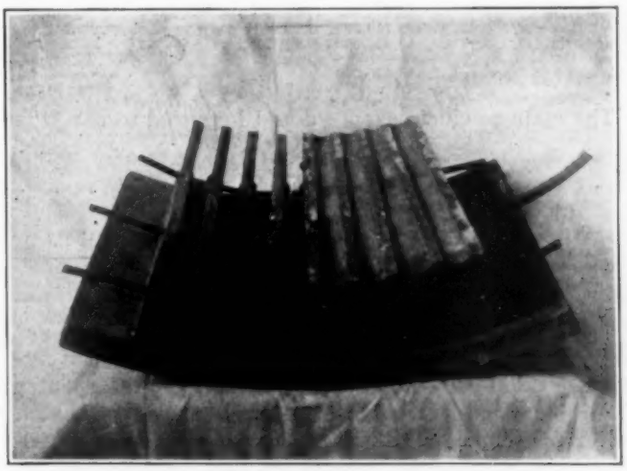
Steam shovel dippers and gyratory crushers have been trying to outgrow each other for forty years. Half-yard, yard, two-yard and five-yard dippers have had their counterparts in 7, 15, 36, 42 and finally 60-in. intake gyratory crushers. The latest achievement is the giant "Bulldog" having two intakes, 190-in. annular segments 60 in. wide, and an output of 2500 tons per hour. The Traylor Engineering & Mfg. Co., of Allentown, Pa., built this 60,000 tons per day world's record machine on special order in 3½ months. The dimensions and weight of the principal parts are:

Height	17 ft. 8 in.
Diameter	19 ft. 6 in.
Shaft length	21 ft.
Shaft diameter	3 ft.
Receiving openings	15 ft. 10 in.
Pulley	7 ft.
Eccentricity	2 in.
Shaft	28 tons
Shaft bearings, etc	34 tons
Head	30 tons
Top shell (2 pieces)	54 tons
Middle shell	50 tons
Bottom shell	47½ tons
Bottom shell lining	5 tons
Spider	30 tons
Complete crusher	278½ tons

The capacity with limestone reduced to 8 to 9 in. is from 2500 to 3000 tons per hr. The power required is 75 hp. with light running to 350 hp. with full load. The rate of running is 240 r.p.m. About 9 bbl. of lubricating oil is used in the system and is pumped continuously through the eccentric bearings, etc. Patents are applied for, Messrs. Richard Bernhard and L. J. Hewes being the engineers in charge of the development.

New Tube Mill Lining

Metallurgists will be interested in the description and illustration of a new tube-mill lining developed by F. B. Kilbourn of Montreal and manufactured by Burnett & Crampton, Rigaud, Quebec, Canada. As shown in the illustrations it consists of a series of chilled iron T-bars set on edge and spaced from three-



DETAIL OF TUBE MILL LINING

SHOWING CORRUGATED SURFACE DEVELOPED DURING USE

quarter inch to one inch apart. The volume between the bars is filled with a rich cement grout, and when this is set the tube mill is ready for operation. After a few hours' running the concrete is somewhat worn, leaving the bars protruding and giving a corrugated surface which effectually lifts the contents of the mill. It is reported that the mill, as shown in the illustration, suffered a wear of only one-eighth inch after 5000 hours of operation. It is reported also that the wear is uniform.

Synopsis of Recent Chemical and Metallurgical Literature

Progress in Japanese Chemical Industries — Mr. Michel Annebault has given in the December, 1918, issue of *Chimie et Industrie* quite a lengthy description of the economic evolution of modern Japan, of which the following is a succinct abstract.

In 1858 the total Japanese foreign commerce, export and import, amounted to about $13,560,000; in 1894 it was about $119,195,000; in 1904 about $156,635,000, and in 1916 it reached about $435,153,000.

During 1916 the figures for export and import tradings with the principal countries were:

Exports to:	About	Imports from	About
France	$33,066,000	France	$2,154,000
China	99,556,000	Germany	2,139,000
British India	36,998,000	China	56,123,000
United States	175,770,000	British India	92,712,000
Great Britain	53,030,000	United States	105,428,000
		Great Britain	42,237,000
Total	$398,420,000	Total	$300,793,000

The main products exported and imported were:

	Exports About	Import About
Sugar	$9,005,000	$9,368,000
Pharmaceuticals	20,516,000	28,635,000
Dyes		4,382,000
Oil and fats	10,186,000	8,982,000
Paper (raw materials)	7,418,000	8,395,000
Ores and metals	74,550,000	8,376,000
Manufactured metals	8,572,000	5,510,000
Machinery	18,052,000	16,166,000

The cheap labor conditions in Japan greatly favor her industrial development. Thus, for example, official figures for 1906 gave as labor wages per day: Carpenter about 45c, printer about 26c, tailor about 23c; in match factories women were paid 3c per day to label match boxes. A noteworthy remark is that in 1904 out of 558,041 persons employed in industrial factories 313,001 were women. The very efficient propaganda that "Japan must break foreign competition, otherwise she will be lost," is contributing more than anything else to keep the standard of wages so very low.

In 1914 the chemical industry in Japan was practically embryonic, but now the Japanese not only manufacture most of the chemicals needed for the rapidly increasing local consumption, but they also export a great number of them. To mention only a few:

Potassium Chlorate—Previous to the war potassium chlorate was imported mainly from Germany; but since importation was forcibly stopped plants have been installed for the treatment of seaweed, and now the Japanese can produce 10,000 tons of potash annually, and have even become exporters of potassium chlorate to the United States. Progress is now being made toward the large-scale manufacture of potassium cyanide.

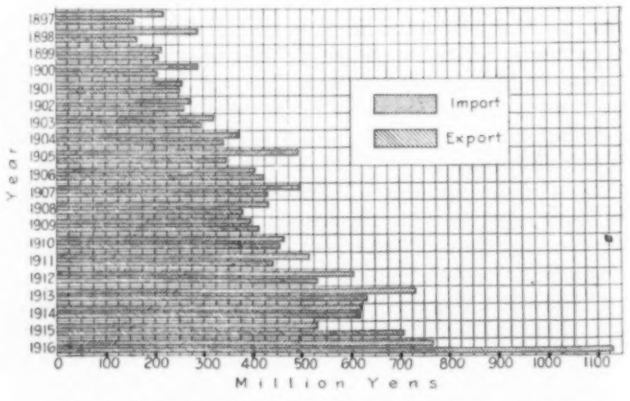
Phosphorus—Practically all the phosphorus needed in pre-war times was imported from Europe; now the local production is amply sufficient for the increased needs.

Matches—The rapid development of the industries of phosphorus and potassium chlorate is intimately connected with the progress of the Japanese match industry. Japan is now one of the world's principal purveyors of matches.

Iodine—The treatment of seaweed for iodine at Hokkaido, Kanagawa, Chiba and Fukuoka is very successful. Japan is now a big exporter of iodine and potassium iodide.

Sulphuric Acid—Japan produces now about 3000 tons of 52 deg. B. sulphuric acid per day, and exportation is rapidly increasing.

Gas Plants—In 1870 there was only one gas plant in all Japan, located at Yokohama. Now there are about 120 plants manufacturing mainly coal gas and the by-products, ammonium sulphate, benzol, cresol, napthalene, phenol, anthracene and other tar derivatives. Ammonium sulphate is also manufactured in electrochemical



TOTAL JAPANESE FOREIGN COMMERCE—IMPORT AND EXPORT

plants for the fixation of atmospheric nitrogen. Phenol is manufactured synthetically, mainly at the Osaka Dye Works.

Artificial Fertilizers—In 1887 the first artificial fertilizer plant was installed at Kamayabori, but this industry progressed slowly, due to the fact that the Japanese relied mostly on natural fertilizers. With the increased agricultural demand the production of artificial fertilizers has progressed proportionately, and now it is one of the well-established industries.

Artificial Dyes—The industry of artificial dyes, which

was practically nil before the war, is now represented by 89 factories, and the life of this industry is more or less insured by government protective laws.

Pharmaceuticals—In 1884 there was in Japan one plant for the manufacture of pharmaceuticals, and this one needed government help for its upkeep. Now there is a number of successful plants, and they are already practically independent of foreign import.

Oils and Fats—The production of oils and fats reaches now about $13,950,000, and this has contributed to the development of the industrials of soap (about $4,443,000), candles, (about $2,377,000), fatty acids and glycerine (about $2,584,000), etc.

Paints, Gum Lacs and Varnishes—These industries started in 1887 with a small plant (the Nippon Paints Co.), and it had a hard struggle up to the time of the war. Now there are many plants with a production worth about $1,550,000, and the demand is on the increase.

Rubber—The first plant in Japan was founded in 1887 at Asakusa. At the present time there are nearly 100 plants, and they are able to export rubber and rubber products. Japan's exportations of rubber tires alone amount to about $2,100,000.

Ceramics—The crockery and porcelain industry is very old, but it was not until 1868 that Occidental processes of manufacture were introduced. Since then the total production has increased to more than $9,000,000.

Enameled Ware—Previous to the war all the enameled metal-ware had to be imported from Europe; now the local industry supplies all the nation's needs and exportations amounting to about $1,035,000 are made to Australia and China.

Glass—Starting with a small plant in 1871, the glass industry has grown until glass of different qualities is exported to the amount of about $5,170,000.

Cement—In 1880 the first cement plant was installed in the Department of Yamagushi. This plant's production has increased tenfold (about 4,000,000 tons), and there are now 20 other plants, mostly in the Departments of Tokio and Orsake.

Paper—Occidental methods for the manufacture of paper were introduced in 1868. At the present time there are a great number of paper factories, which, besides producing the 225,600 tons of common printing paper for local use, also export to China and India about $8,800,000 worth. The manufacture of the special Japanese paper has also increased since the introduction of machinery, and production has reached about $10,600,000 worth and is still increasing.

Plastic Materials—This is a very recent industry in Japan, although practically all the camphor, which is one of the main raw materials, comes from Japan.[1] The first celluloid plant was installed after the Russo-Japanese war. There are now 12 plants, producing annually 2700 tons of celluloid, and celluloid is exported to Europe and America.

Sugar—Although the first beet sugar factory was put in operation in 1881 only a negligible quantity was produced up to the time when Japan came into possession of the Island of Formosa, which is a great producer of sugar beets. The industry has progressed to such an extent that in 1916 Japan practically supplied her own needs and now she can even export sugar.

Electrochemistry—Japan has taken up and greatly developed this industry, and besides the electrochemically manufactured products already mentioned, she produces now on a large scale carbides, artificial graphite, metallic sodium, caustic soda, sodium chlorate, nitric acid, chlorine and many other chemicals.

In viewing the progress made by Japan in the main chemical industries it becomes evident that she has directed her mental and monetary resources to the manufacture of the products she imported in pre-war times mainly from Germany, and that she has succeeded in emancipating herself to such an extent that she will become Germany's successful competitor in the foreign markets.

[1] EDITOR'S NOTE.—The output of camphor in 1917 was about 10,000,000 kin (a kin is 1.325 lb.), of which 70 per cent was produced in Formosa and 30 per cent was supplied by domestic producers. But since the wartime the output has gradually decreased on account of rise of wage. Last year's output was only 8,000,000 kin. This year's production is estimated to be still less, viz., 6,000,000 kin. Nowadays about 12,000,000 kin is annually demanded by celluloid makers, while camphor culture is too slow to meet this demand. This shortage of material will be supplied only by the foreign producer.

Recent Chemical and Metallurgical Patents

Complete specifications of any of the United States patents abstracted herein may be obtained by remitting 5c. each to the Commissioner of Patents, Washington, D. C.

Calcium Bisulphite.—In order to produce calcium bisulphite continuously, ALBERT G. HINZKE of Toronto has designed an apparatus in which the counter-current flow of lime water and sulphur dioxide may be reversed at will, thus preventing the formation of incrustations which tend to clog the openings in the absorbing system. Fig. 1 shows the apparatus in

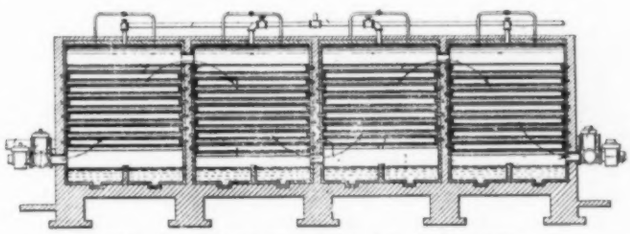


FIG. 1. CROSS-SECTION OF ABSORBER

vertical cross-section. The four compartments are lined with acid-resisting material and are provided with a number of perforated splashboards. Assuming that the sulphur dioxide enters at the left, its course is indicated by the arrows. In this case the lime water is introduced through the central pipe in the top of the right hand chamber and is circulated progressively through the other compartments. The circulating system is shown more clearly in Fig. 2. A flow-box is interposed between each two compartments and the corresponding pumps. This box is divided by partitions in such a manner that, while a constant circulation is maintained through the sprayers in each chamber, there is also a movement of liquid from chamber to chamber toward the end at which the gas enters. Here the saturated solution is drawn off continuously to a storage tank. (1,303,314; assigned, by mesne assignments, to Ainwell G. McIntyre; May 13, 1919.)

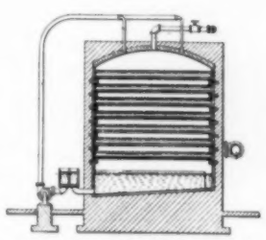


FIG. 2. CIRCULATING SYSTEM

Electrodes for Caustic Cells.—CLARENCE W. MARSH of New York City has patented an improved construction of electrodes for cells engaged in the manufacture of chlorine or caustic alkali, one application of which is shown in Fig. 3. As the old anodes wear out they are replaced by those of sectional type (5); at the same time the flat perforated cathodes are replaced by bent plates (8) so shaped that the distance between electrodes is approximately constant. The great advantage of this style is that gases which form on the anodes in rising to the surface strike the under side of the section immediately above and are deflected into the inactive center part of the cell. In this way is provided an increased resistance of the upper part of the cell due to excess gas in the electrolyte, and better circulation is maintained. Step-construction of cathode increases the support for diaphragm (12), which may be correspondingly reduced in thickness with an attendant lowering of electrical resistance. Altogether, this construction reduces the necessary impressed voltage by 0.5 volt. (1,302,824; May 6, 1919.)

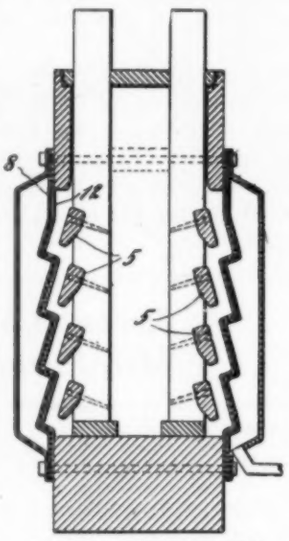


FIG. 3. ELECTRODE

Electric Furnace. — O. A. COLBY and FRANK THORNTON, JR., of Pittsburgh, Pa., have patented an electric furnace with protected electrodes (20) and a compound resistor capable of continuous operation at high temperatures. When the furnace, such as shown in Fig. 4, is held at about 1000 deg. C., the hottest portion of the carbon resistor is nearly 2000 deg. C., due to the negative temperature resistance of carbon. Now in order to prevent the hearth foundation (12) from being overheated despite the special refractory (18) the resistor is sectionalized to have a lower layer of high resistance material, thus carrying a lesser amount of current. Various combinations are suggested, such as a layer of crushed graphite (16) above, renewable through side hoppers, and underlain by crushed charcoal (17). Or the crushed graphite may graphite or amorphous carbon may be buried in the upper part of a crushed graphite layer. A further expedient to prevent overheating of the hearth refractories consists of providing a pre-heating chamber in the foundation brickwork (12). (1,306,250-251-289; assigned to Westinghouse E. & M. Co.; June 10, 1919.)

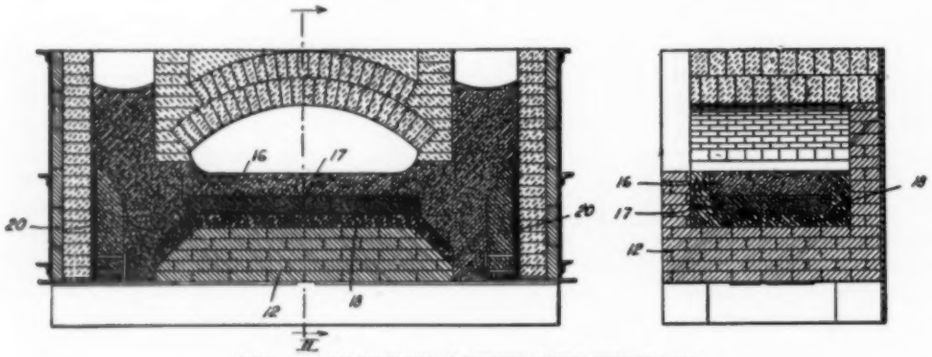


FIG. 4. ELECTRIC RESISTANCE FURNACE

Disintegrating Metals.—E. J. HALL of New York City patents a method for disintegrating metals, in which molten metal drops in a fine stream through an atmosphere of inert gas into a circulating bath of cold liquid which does not react with the metal in any way. In this way chilled particles of pure metal are available for further grinding under inert oil to produce particles of the required size. (1,306,060; assigned to Metals Disintegrating Co.; June 10, 1919.)

Electric Furnace.—IVAR RENNERFELT of Djursholm, Sweden, has patented a furnace, shown in Fig. 5, wherein electrodes (1) project through a movable roof (2) and make contact with renewable granular carbonaceous material held on shelves at the side walls. The brickwork of the furnace is here protected from excessive heat by a thick lining of magnesite or carbon bricks (7). Various shapes of furnaces can be adapted to polyphase current, connected either in star or delta, to hold one or more shallow crucibles (4) for melting glass or metals, or the furnace may be made into a hearth. Residue from the combustion of electrodes is

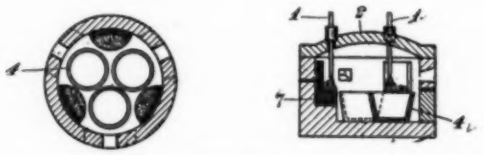


FIG. 5. ELECTRIC FURNACE WITH MOVABLE ROOF

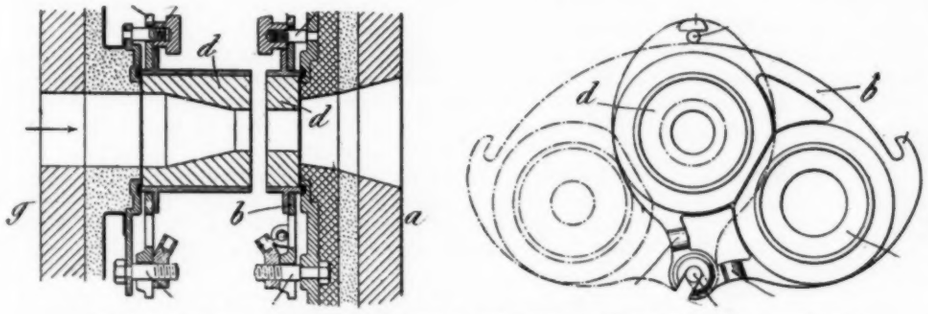
by this construction kept from contaminating the bath, and a strong and uniform heat had by the electrode arrangement and by reverberation from the furnace walls (1,305,167; May 27, 1919.)

Alloy for Glass Molds.—An alloy consisting of copper, 56-64 per cent; nickel, 13-17 per cent; zinc, 10-15 per cent; iron, 10-15 per cent, resists oxidization at high temperatures. In addition, it can be machined easily, so that it is especially suitable for the manufacture of glass molds. (1,310,363; FOSTER MILLIKEN of Lawrence, N. Y.; July 15, 1919.)

Deborating Chile Saltpeter.—ROBERT P. CALVERT and OTHO L. THOMAS of Wilmington, Del., have devised a novel method for removing borates from crude saltpeter or the refining by-product known as the potash crystal fraction, which contains from 20 to 50 per cent potassium nitrate and from 3 to 7 per cent boric acid, etc. Sufficient mineral acid is added to liberate all the boric acid, the salts are evaporated to dryness, methyl alcohol added and methyl borate distilled off in the presence of a dehydrating agent. The ester is hydrolyzed, freeing the boric acid and converting the alcohol back for another cycle. Since borax is a very injurious impurity in all the uses to which caliche salts

are applied, such as fertilizer, black powder, etc., this process should prove to be important. (1,308,576-7; assigned to E. I. du Pont de Nemours & Co.; July 1, 1919.)

Ports for Tilting Furnace.—A. M. AUBERT of Billancourt, Seine, France, patents a new port for a tilting regenerative furnace, fired by liquid fuel, shown in Figs. 6 and 7. Each regenerator and the adjacent furnace and has a lunette (*b*) attached to it, but separated from each other by a space sufficient to allow entrance of a pipe carrying the liquid fuel. In the position shown, hot air from the regenerator (*g*)



FIGS. 6 AND 7. A NEW PORT FOR A TILTING REGENERATIVE FURNACE

passes through the fire clay ports (*d*) into the furnace chamber (*a*), there burning the sprayed fuel. At the other end, the hot gases pass off through larger ports into another regenerator. Upon reversal, the fuel valves are changed, and all lunettes shifted as shown in dotted lines (Fig. 7), so that the small inlet ports may be replaced by larger exit ones and vice versa. (1,304,725; May 27, 1919.)

Burning Crushed Coal.—J. M. SCHULTZ of Chicago patents a method of burning crushed coal, and various forms of burners applicable. He proposes to take fuel and crush it as fine as practicable without previous drying, thus being much coarser than pulverized coal burned in suspension. This fuel is then blown into a burner at a uniform rate with sufficient air to burn the

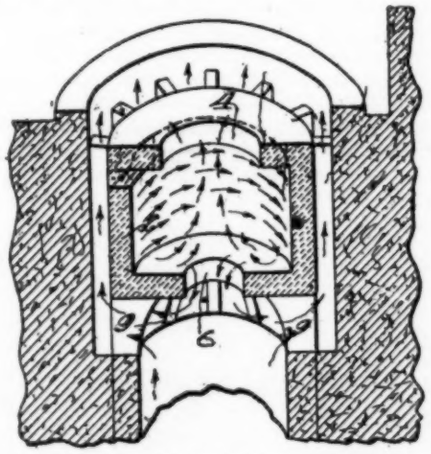


FIG. 8. METHOD OF BURNING CRUSHED COAL

fixed carbon to CO through tangential tuyeres near the top of the annular pot shown in sectional perspective in Fig. 8. Here the contained water is first evaporated, then volatiles driven off, and the remaining coked particle pursues a downward helical path. By the time the coarsest piece is consumed, the remaining ash is fused, and this slag drips out of the lower hole 6 in liquid condition. The products of combustion largely are deflected inward and upward, blowing out the upper hole 4, there to be burned completely by auxiliary air drawn through the outer passages 9. The pot itself is protected from inward scour by a self-renewing layer of viscous fuel ash, while destruction by superheating is prevented by the air currents through 9. Clogging of the slag hole 6 is prevented by a portion of the flame pulsating downward at this point. (1,306,233-234-235; assigned to Schutz Hawley Co.; June 10, 1919.)

Molybdenum-Tungsten Alloy.—FREDERICK G. KEYES has patented a process for the manufacture of a molybdenum-tungsten alloy which may be drawn into wire and used for lamp filaments or resistance-wire for electric tube-furnaces. Chemically pure MoO_3 and WO_3 are pulverized, mixed in desired proportions and reduced to metallic form by heating to between 800 and 1000 deg. C. in a current of hydrogen or carbon monoxide. The metals are mixed with water, molded into a bar under pressure, dried, and then heated to 1200 deg. in a stream of hydrogen to reduce any molybdenum oxide that may have been formed during the drying and molding operations. The bar is again heated by an electric current until the temperature has attained that of the melting point of molybdenum. The alloy thus formed preferably contains about 20 per cent molybdenum, and when heated to between 800 and 900 deg. C. is both malleable and ductile. (1,308,907; assigned to Cooper-Hewitt Electric Co., July 8, 1919.)

Elimination of Carbon Dioxide and Oxygen From Electric Furnaces.—JOHN THOMSON of New York has patented a process by which the practical use of an electric resistor furnace, for the distillation of zinc, is made possible by covering the charge with a layer of granular carbon. The carbon resistor is located above the charge and heats by radiation through this granular layer, which is maintained at a temperature between 1000 and 1100 deg. C. At this temperature the following reaction takes place, from left to right:

$$CO_2 + C \leftrightharpoons 2CO$$

Any oxygen present in the furnace will react with zinc to form "blue powder," and thus zinc oxide will be converted to metallic zinc and carbon monoxide according to the equation:

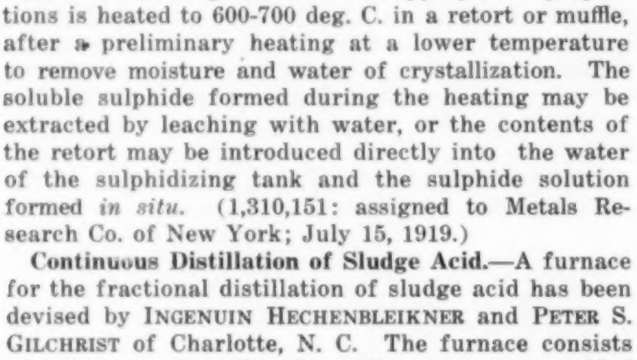
$$ZnO + C = Zn + CO$$

The granular carbon layer acts as a filter through which the zinc vapors and gases must pass, the oxygen and carbon dioxide being eliminated. (1,308,879, July 8, 1919.)

Sulphidizing Solution.—In view of the fact that the majority of plants using the sulphidizing process for the flotation of oxidized ores are so situated that the soluble sulphides required for the treatment have to be secured from distant points, RAYMOND F. BACON proposes to manufacture the desired sulphide solution at the flotation plant. Natural alkali and alkaline earth materials, such as lime and the carbonates, hydroxides and borates of the alkali or alkaline earth metals, are available in mining regions and afford a

cheap source of alkali, while iron pyrites, copper pyrites, flotation concentrates, etc., may be used to supply the sulphur. A mixture of sulphur-bearing and alkali-bearing material in appropriate proportions is heated to 600-700 deg. C. in a retort or muffle, after a preliminary heating at a lower temperature to remove moisture and water of crystallization. The soluble sulphide formed during the heating may be extracted by leaching with water, or the contents of the retort may be introduced directly into the water of the sulphidizing tank and the sulphide solution formed *in situ*. (1,310,151: assigned to Metals Research Co. of New York; July 15, 1919.)

Continuous Distillation of Sludge Acid.—A furnace for the fractional distillation of sludge acid has been devised by INGENUIN HECHENBLEIKNER and PETER S. GILCHRIST of Charlotte, N. C. The furnace consists of an outer casing of acid-resisting masonry, provided with a grate and an ashpit. Through the top of this



FURNACE FOR CONTINUOUS DISTILLATION OF SLUDGE ACID

casing a cylinder of acid- and heat-resisting material projects into the body of the furnace, dividing the latter into two zones, each of which has a separate gas outlet. The top of this cylinder is closed with a bell hopper, through which coal may be fed as required, and is provided with a number of drip pipes for introducing the sludge acid. When coal is supplied to the furnace in sufficient quantity to maintain the upper level of the fuel bed within the cylinder, as shown in the illustration, a high-temperature zone is obtained in the lower fuel bed and a lower-temperature zone with the cylinder. The aqueous and tarry constituents of the sludge acid distill off during the passage of the acid through the low-temperature zone and pass to the tar condenser. The sulphuric acid vapors liberated in the high-temperature zone are collected in a separate condenser. Each condenser is provided with an exhaust fan for the removal of waste gases. (1,310,078; assigned to Chemical Construction Co.; July 15, 1919.)

Cellulose-Nitrate Composition.—A mixture which is capable of producing a very flexible, transparent and uniform film is obtained by incorporating in 65 parts of acetone or methyl alcohol 10 parts of cellulose nitrate and 2 parts of butyl oxalate. HANS T. CLARKE of Rochester, N. Y., states that the butyl oxalate may be replaced by any dialkyl ester of oxalic acid in which each of the alkyl groups contains 4 or 5 carbon atoms. The plasticity and flexibility of the composition may be increased by the addition of softeners, such as amyl acetate, ethyl propionate, urea, castor oil, triphenyl phosphate, dibutyl sulphone, etc. (1,309,981; assigned to Eastman Kodak Co., July 15, 1919.)
Kodak Co., July 15, 1919.)

Personal

BRIG.-GEN. AMOS A. FRIES has been awarded the Distinguished Service Medal for exceptionally meritorious and distinguished services, officially set forth as follows: "As chief of the Chemical Warfare Service, he was charged with the important task of training and equipping our troops for a form of warfare in which the American Army had had no experience prior to the present war. Both in securing proper defensive measures against gas and in developing new methods for its use as an offensive agency, he performed his arduous duties with marked success, thereby rendering valuable services to the American Expeditionary Forces."

MR. CHESTER H. JONES, formerly a Captain in the Chemical Warfare Service, has joined the editorial staff of CHEMICAL & METALLURGICAL ENGINEERING. His headquarters will be at the Chicago office of the McGraw-Hill Co. in the Old Colony Building.

PROFS. H. R. MOODY and RESTON STEVENSON will return to the College of the City of New York in September. Dr. Moody was special expert with the War Industries Board and Dr. Stevenson served in France as Major in the Sanitary Corps.

MR. ELLWOOD HENDRICK, consulting editor of CHEMICAL & METALLURGICAL ENGINEERING, has returned to New York after a month's trip to South America.

MAJOR MARION G. DONK of the Chemical Warfare Service, who was in charge of Government work on bromine production at the Dow Chemical Co. plant at Midland, Mich., has joined the staff of the Hercules Engineering Corporation.

LIEUT. CLIFFORD L. SNYDER, who has recently been discharged from the army, has joined the technical staff of the Detroit Testing Laboratory as sales engineer. Lieut. Snyder received his commission at Fort Sheridan, Illinois, and was later transferred to the Nitrate Division in charge of construction work at Plant No. 1, Sheffield, Ala.

Current Market Reports

The Non-Ferrous Metal Market

Monday, Aug. 11.—The non-ferrous metal market continues to be quiet, production is substantial and prices firm. Speculative buying is not so attractive as formerly.

Aluminum:—The market is quiet, 98-99 per cent ingots are now quoted at 33c. per lb. Scrap has declined; cast, 21-24c.; sheet, 22¼-25c.; and clippings 23½-27c.

Antimony:—The market is easy, spot wholesale lots offering from 9½-9¾c. and jobbing lots, 9¼-9⅝c. per lb.

Copper:—Quotations have not changed. Spot 23-23¼c. September futures, 24c.

Copper sheets, hot-rolled	lb.	33.50 —	
Copper sheets, cold rolled	lb.	35.00 —	
Copper bottoms	lb.	41.50 —	
Copper rods	lb.	24.75 —	25.00
Copper wire	lb.	26.00 —	
High brass wire and sheets	lb.	27.75 —	
High brass rods	lb.	26.75 —	
Low brass wire and sheets	lb.	30.50 —	
Low brass rods	lb.	31.25 —	
Brazed brass tubing	lb.	39.00 —	
Brazed bronze tubing	lb.	44.25 —	
Seamless copper tubing	lb.	37.75 —	
Seamless bronze tubing	lb.	44.25 —	
Seamless brass tubing	lb.	36.00 —	
Scrap, heavy machinery comp		18 —	19
Scrap, heavy and wire		18½ —	19½
Scrap, light and bottoms		13 —	14
Scrap, heavy, cut and crucible		20 —	21½
Scrap brass, heavy		9 —	12
Scrap brass, casting		13½ —	14
Scrap brass, light		10½ —	11½
Scrap, No. 1 clean brass turnings		11 —	11½
Scrap, No. 1 comp. turnings		16 —	17

Lead:—Lead continues quiet. New York quotations vary from 5¾-6c. East St. Louis, 5.3c. lb.

Tin:—Spot tin remains at 70c. with very few sales.

Zinc:—Spot spelter is offered at 7.60c. in New York and 7.25c. in East St. Louis.

OTHER METALS

Bismuth	lb.	$3.10 —	.....
Cadmium	lb.	1.50 —	1.75
Cobalt	lb.	2.50 —	3.50
Magnesium	lb.	1.75 —	2.10
Mercury	75 lb.	109.00 —	.....
Nickel	lb.	.41 —	.45
Iridium	oz.	175.00 —	.....
Palladium	oz.	115.00 —	120.00
Platinum	oz.	105.00 —	110.00
Silver	oz.	1.12½ —	.....

The Iron and Steel Market

The monthly ingot report of the American Iron & Steel Institute shows that 2,508,176 gross tons of steel ingots were produced in July by 30 companies which in 1918 made 84.03 per cent of the industry's total ingot output. The indicated rate for the whole industry is 35,700,000 tons per annum, or 73 per cent of capacity, estimating capacity at 49,000,000 tons. Correspondingly June had shown 67 per cent, May 54 per cent and April 65 per cent. The figures indicate a dip to a rate of about 50 per cent at the middle of May, also to a rate of fully 75 per cent at the end of July, representing a gain of one-half in the rate in the short period of two and a half months. The year had opened up with production at about 87 per cent of capacity. Despite the wide fluctuation the rate in July and the average rate in the first half of the year were almost precisely the same, 72.3 per cent for the half-year and 72.9 per cent for July.

The Steel Corporation's unfilled obligations increased by 685,806 tons during July, this comparing with an increase of 610,545 tons in June, and decreases running quite uniformly, with an average of 640,000 tons a month, during the six months preceding, December to May inclusive. While the booking of actual shipping orders was heavy in June and July, particularly in July, the increase in the unfilled tonnage was of course due largely to the placing of contracts, as the monthly statement includes contract obligations. The total of such obligations at the end of July was 5,578,661 tons, equal to nearly six months of output, but the distribution as to products is such that in some lines a much longer period of time is represented and in other lines a much shorter period.

Market Conditions Improving

The steel market is no longer entirely one-sided. In April and the fore part of May there was nothing favorable. Orders were light, production was declining and prices were being shaded by many producers. In June there was improvement in all respects and in July the situation from all aspects was good, the various market indicia being wholly favorable.

Now the condition and prospects of the market present two sides. There is room for discussion. Until recently the fact that an order was placed was proof positive that the material was needed, and immediately, for actual consumption. Since several branches of the finished steel trade have become sold up, immediate delivery of such products is not assured and is in fact practically impossible, and a portion of the buying now in progress may perhaps rest not upon absolutely known and immediate requirements but rather upon the desire of the jobber or manufacturing consumer to protect his future.

The general industrial developments of the first half of August have been quite unfavorable to the iron and steel industry. The greatest lack the steel market has had has been railroad orders, and the demands railroad labor has lately made prevent any hope of there being an early decision as to the future status of the railroads whereby steel orders involved in upkeep and betterments could be placed. The obviously growing labor unrest affects the steel trade at another point. Its lack, besides that of railroad buying, has been in orders involved in large construction or investment undertakings, along which line there has been relatively little steel demand. The new developments as to labor are such as to make the general investor more conservative, and the outlook for steel orders involved in investment projects is distinctly less favorable than 30 days ago, whereas a continued improvement had been expected.

Prospects have greatly diminished that there will be any important advances in the near future in either pig iron or steel prices. Until very recently there were many predictions that an advancing market was a matter of the very near future. It is doubtful whether the market was directly in line for advancing prices through the operation of the law of supply and demand, and it may be that the steel producers who predicted price advances did so from adherence to the steel trade's traditional philosophy that the way to stimulate buying is to have an advancing market. The Steel Corporation, however, had allowed it to become known quite plainly a couple of months ago that it was positively opposed to steel price advances, this year at least, and while the independents who favored advancing prices may have thought for a time that the Steel Corporation's hand could be forced, the universal outcry over the high cost of living and the general recognition of the interdependence of all commodity price advances with wage advances make price advances, no matter in what commodity, very unpopular.

Some Furnaces Advance Prices on Pig Iron

The pig iron market is not to be judged finally by surface indications. The Alabama furnaces have advanced to the $26.75 price of March 21, placing them on a level, f.o.b. furnace, with many Northern furnaces when they have much freight to absorb to reach the limits of their usual distributing territory. Chicago district furnaces are reported to have advanced their prices $2 a ton, and two Cleveland producers have announced advances of 50c. These incidents are not proof of fundamental strength in the pig iron market, which sometimes exhibits signs of advancing because conditions are unfavorable, and sometimes declines because prospects have improved. The reason for such divergences from what would be regarded as reasonable conduct for a commodity market is that a furnace must either run or not run, while a short blast is expensive. The furnaces in operation are well sold and if conditions are not sufficiently promising to induce idle furnaces to blow in, the furnaces that are sold up may very naturally advance their asking prices. Merchant pig iron was produced at 10 per cent lower rate in July than in June, which easily accounts for there being far from a plethora of pig iron, but the July output was not over about 55 per cent of capacity, and in such circumstances a general and genuine advance in prices actually paid for pig iron is quite improbable, and it would be at the same time entirely without precedent. When there are many idle furnaces a marked improvement in the outlook induces idle furnaces to decide to get into blast, and such decisions are always followed promptly by the selling of "backlog" tonnages, frequently at more or less concessions from the going market.

Export Trade

The smallest iron and steel exports since 1915 fell in February of this year, 234,793 gross tons. Thereafter there was continued improvement until 544,580 tons were reported for June. Export demand has been moderately uniform for several months and the June tonnage is probably fairly representative of what is to be expected for some time to come. To compare exports with productive capacity it is of course necessary to eliminate scrap, pig iron, castings, etc., and when this is done it is seen that the steel exports of June were at the rate of a trifle less than 6,000,000 tons a year, on the finished rolled steel basis, capacity in which may be taken at 37,000,000 gross tons a year. Thus, referring only to steel, June exports represented about 16 per cent of capacity, or about 24 per cent of production, since the mills were operating at about 67 per cent during the month.

The best export year before the war was 1912, with about 2,400,000 tons of rolled steel or equivalent exported, that being about 11 per cent of the year's production, or about 10 per cent of the existing capacity. Thus exports have increased by about 150 per cent. To use definite figures, capacity may be said to have increased by 13,000,000 tons a year and exports by 3,600,000 tons.

The Chemical Market

New York, August 9, 1919.

Trading in heavy chemicals continues brisk for both domestic and export account, with *sodium bichromate* still holding the center of interest. Practically no changes in price in the general list have developed. An abrupt slump in the hitherto active vegetable oils, a sharp rise on the part of spirits of turpentine, with other naval stores in sympathy, complete the salient features of the local market during the past two weeks.

Heavy Chemicals

With only one manufacturer making *sodium bichromate*, this chemical has risen from 11-12c. per lb. to 15-16c., although car lots are offered at 14½c. The consuming demand is still large, most of the export shipments going to England. Heavy sales of *potassium carbonate* made to manufacturers in the Middle West and to Denmark are reported at 17c. per lb.

Caustic soda is holding firm at the quotation established three weeks ago, while export orders show a slight diminution.

Iodine, resublimed, having advanced abroad, local dealers are asking 25c. more than the previous quotation of $4.25 per lb.

Better demand has led some manufacturers to advance *glycerine* 1c., making the present price 21c. per lb.

There has been a strike in the *phosphate* mining fields, particularly in Florida, for the past three months and this is still on. No phosphate has been shipped and it appears not likely that any will be for some time. *Phosphoric acid*, all *sodium phosphates*, *acid phosphates* and *fertilizers* are affected by the strike and are accordingly expected to rise.

Coal-Tar Products

While there are no outstanding features among the coal-tar products, business in these items is on a firm footing with the increasing production of the textile mills gradually swelling the demand. Among the intermediates, aniline oil, aniline salts and dimethylaniline are being consumed in large volume. Following the advance in aniline oil recorded at the last writing, dimethylaniline has risen from the minimum quotation of 50c. to 52c. per lb. Quotations on *phenol* are nominal, pending the official announcement by the Government of the price at which its huge stock of this product is to be sold. Affected by this situation and the heavy demand, *salicylic acid*, U. S. P., is selling at 35-45c. per lb., the technical grade at 30-40c. per lb., in comparison with 30-35c. and 25-30c., respectively, two weeks ago.

Vegetable Oils

Vegetable oils are suffering a relapse from the active speculation of the past few months. The heavy buying from abroad has stopped abruptly as has the domestic. The present slump is attributable in the main to the instability of foreign exchange. The values of oils here have been augmenting while at the same time exchange has been declining. Buyers are between two fires and discreetly have withdrawn from the market. This condition is only temporary and within a short time satisfactory adjustments will be effected.

With the exception of cottonseed oil, there have been few changes in price on spot oil. Futures, however, dropped for a time, but are now back on the level and moving upward.

There have been serious losses of seed in some parts of the linseed-producing States. Until the new crop in November no improvement over present conditions is likely, especially as long as speculative interest is active. The trade is, therefore, awaiting developments while quotations remain unchanged.

Naval Stores

Two weeks ago spirits of turpentine was selling at $1.25-$1.27 per gal., which was a record figure. At this writing none is for sale in this market and it is nominally quoted at $1.75-$1.80. The market at Savannah is steadily advancing, having at present reached $1.71½ per gal. Both export and domestic buying have vied in vigor, the former having slightly the advantage. As a new feature, demand from Germany is reported increasing.

Likewise, stocks of rosins are exceedingly low with all grades bringing fancy prices.

Emulating the naval stores market, pine oil, steam distilled, has advanced 17c. per gal. from the previous quotation of 78c.

St. Louis, August 5, 1919.

Heavy Chemicals:—The outstanding development in the local market in the past two weeks has been the heavy demand for 60 per cent sulphuric acid and the strong market for nitric acid. The latter was expected to show a sharp decline about Aug. 1, when Government support was removed, but it has more than held its own.

The heavy demand for 60 per cent sulphuric acid has forced the price up 50 cents a ton and it is now averaging $12. The fertilizer people as usual are making the market and orders are coming in at such a rate that local producers are keeping busy.

The *66 per cent sulphuric acid* is quiet at $18 a ton. Business is good, especially if account is taken of slackness in steel-making, particularly marked at present in St. Louis, where many steel mills are running at low ebb.

Muriatic acid is quiet, 18 per cent selling for $22 in tank car lots. *Sodium bisulphate* (*niter cake*) has changed little since the last report. Local producers report the demand steady and all their production taken.

Nitric acid was expected to slump badly, but has more than held its own since the last report, two weeks ago. The 40 deg. Baumé is selling at 10 and 10½ cents a lb., 38 deg. at 9 cents, and 42 deg. at 11 cents.

Zinc chloride is very active and an advance in price is looked for. The 50 per cent sells at 4 cents a lb. in tank car lots, and some sales have been reported as low as 3¾ cents in spite of the advance of zinc.

Zinc oxide is reported strong by local producers. No price change has been made, but producers believe the persistent and heavy demand may force a rise. Prices remain at 8 to 9 cents a pound, according to lead sulphate content, in car lots and half a cent higher for smaller quantities.

Chicago, August 7, 1919.

In the main, the heavy chemical market is remaining firm, with almost the entire line in good demand, sodium bichromate still holding the local spot-light at a quotation of 15c. No fluctuation and no undue activity are apparent in the coal tar products, prices remaining the same. The pine tar line, however, is furnishing enough activity to make up for any lack of interest in other lines.

Heavy Chemicals:—Sodium bichromate, on which a 4c advance was recorded on Aug. 1, is up 4½c more, to 15c a pound, with dealers having difficulty in supplying the demand. Potassium carbonate is being held at 19c with sales active. A quotation on yellow potassium prussiate of 68c is almost meaningless, as there is none to be had even at this figure. The red is also up 20c, $1.10 being the current quotation, with supply very limited.

The acids show no change on the local market. Although sales of sulphuric have fallen off to some extent, $18 a ton is still the quotation for 66-deg. With good demand, muriatic brings around $22. Activity in sodium bisulphate (niter cake) is not so pronounced, and no change in price has been recorded. Bleach, caustic soda and soda ash are all quoted at prices ruling for the past thirty days.

Vegetable Oils:—This market shows the effect of recent speculation, in that a decided slump has occurred in several items. Linseed oil remains at $2.48, with not much trading taking place. Soya bean oil and cocoanut oil are both off about two cents with holders of stock asking for bids. The quotation on bean oil to-day is 17c. Corn oil, and cottonseed oil both hold firm with fair demand.

Flotation Oils, Naval Stores:—No one seems able to forecast the future for turpentine, $1.65 being asked to-day and many sales being closed at that figure. The main question seems to be one of supplying the demand rather than one of price. It is freely predicted that without embargo turpentine will soon reach $2. Rosin also is up, W.W. bringing $25 and F $21.50. Pine tar and pine tar oil show no change.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, AUG. 9, 1919

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.54 -$0.60
Acetone	lb.	$0.13½-	.15 - .....
Acid, acetic, 28 per cent.	cwt.	2.75 - 3.00	3.00 - 3.25
Acetic, 56 per cent.	cwt.	5.50 - 6.00	6.00 - 6.50
Acetic, glacial, 99½ per cent, carboys	cwt.	12.00 -12.50	13.00 -13.50
Boric, crystals	lb.	.13 - .13½	.13½- .14
Boric, powder	lb.	.13 - .13½	.13½- .14
Hydrochloric, tech. 20 deg.	cwt.	1.00 - 1.50	1.75 - 2.50
Hydrofluoric, 52 deg.	lb.	.10 -	.11 - .....
Lactic, 44 per cent. tech.	lb.	.11 - .14	.12 - .16
Lactic, 22 per cent. tech.	lb.	.05 - .06	.05½- .07
Molybdic, C. P.	lb.	.....	6.50 - 7.40
Nitric, 40 deg.	lb.	.06 - .06½	.07 - .08½
Nitric, 42 deg.	lb.	.07 - .07½	.08 - .....
Oxalic, crystals	lb.	.24 - .25	.25 - .30
Phosphoric, Ortho, 50 per cent. solution	lb.	.09 -	.10 - .14
Picric	lb.	.30 - .40	.50 - .....
Pyrogallic, resublimed	lb.	.....	..... - 2.30
Sulphuric, 60 deg., tank cars	ton	12.00 -14.00	..... - .....
Sulphuric, 60 deg., drums	ton	17.00 -	22.00 - .....
Sulphuric, 60 deg., carboys	ton	20.00 -	25.00 - .....
Sulphuric, 66 deg., tank cars	ton	16.00 -18.00	23.00 - .....
Sulphuric, 66 deg., drums	ton	20.00 -21.00	25.00 -26.00
Sulphuric, 66 deg., carboys	ton	25.00 -	30.00 -40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars	ton	22.00 -	27.00 - .....
Sulphuric, fuming, 20 per cent. (oleum) drums	ton	25.00 -	32.00 - .....
Sulphuric, fuming, 20 per cent. (oleum) carboys	ton	30.00 -	35.00 - .....
Tannic, U. S. P.	lb.	..... -	1.30 - 1.40
Tannic (tech.)	lb.	..... -	.42 - .55
Tartaric, crystals	lb.	..... -	.84 - .86
Tungstic, per lb. of WO	lb.	..... -	1.20 - 1.40
Alcohol, Ethyl	gal.	4.00 -	4.85 - .....
Alcohol, Methyl	gal.	1.20 -	1.23 - .....
Alum, ammonia lump	lb.	.03½- .04½	.04½- .04½
Alum, potash lump	lb.	.08 - .09	.08½- .09½
Alum, chrome lump	lb.	.15 - .16	.18 - .20
Aluminum sulphate, commercial	lb.	.01½- .02	.02½- .02½
Aluminum sulphate, iron free	lb.	.02½- .03	.03½- .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07 -	.09 - .....
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	..... -	.30 - .35
Ammonium carbonate, powder	lb.	.13 - .14	.14 - .14½
Ammonium chloride, granular (white salammoniac)	lb.	.12½- .13	.13½- .14
Ammonium chloride, granular (gray salammoniac)	lb.	.12 - .12½	.13 - .13½
Ammonium nitrate	lb.	.10 -	.11 - .12
Ammonium sulphate	lb.	.05 -	.06 - .....
Amyl acetate	gal.	..... -	3.65 - .....
Arsenic, oxide, lumps	lb.	..... -	.09 - .09½
Arsenic, sulphide, powdered	lb.	..... -	..... - .....
Barium chloride	ton	75.00 -80.00	85.00 - .....
Barium dioxide (peroxide)	lb.	.22 -	.24 - .....
Barium nitrate	lb.	.10 - .10½	.11 - .12
Barium sulphate (precip.) (blanc fixe)	lb.	.02½-	.02½- .04
Bleaching powder (see calcium hypochlorite)	...	..... -	..... - .....
Blue Vitriol (see copper sulphate)	...	..... -	..... - .....
Borax (see sodium borate)	...	..... -	..... - .....
Brimstone (see sulphur, roll)	...	..... -	..... - .....
Bromine	lb.	..... -	.65 - .75
Calcium acetate	cwt.	2.00 - 2.05	2.10 - .....
Calcium carbide	lb.	..... -	.04 - .05
Calcium chloride, fused, lump	ton	19.00 -25.00	30.00 -40.00
Calcium chloride, granulated	lb.	.01½- .01¾	.02 - .02½
Calcium hypochlorite (bleaching powder)	cwt.	1.75 - 1.80	2.00 - 2.50
Calcium peroxide	lb.	..... -	1.50 - 1.70
Calcium phosphate, monobasic	lb.	..... -	.75 - .....
Calcium sulphate, precipitated	lb.	..... -	.09 - .09½
Carbon bisulphide	lb.	.05½-	.06 - .....
Carbon tetrachloride, drums	lb.	.11 -	.12 - .14
Carbonyl chloride (phosgene)	lb.	..... -	.75 - .....
Caustic potash (see potassium hydroxide)	...	..... -	..... - .....
Caustic soda (see sodium hydroxide)	...	..... -	..... - .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 -	.08 - .....
Cobalt oxide	lb.	..... -	1.60 - 1.65
Copperas (see iron sulphate)	...	..... -	..... - .....
Copper carbonate, green precipitate	lb.	..... -	.28 - .31
Copper cyanide	lb.	..... -	.65 - .70
Copper sulphate, crystals	lb.	.08½- .08¾	.09 - .09½
Cream of tartar (see potassium bitartrate)	...	..... -	..... - .....
Epsom salt (see magnesium sulphate)	...	..... -	..... - .....
Formaldehyde, 40 per cent.	lb.	..... -	.20 - .21
Glauber's salt (see sodium sulphate)	...	..... -	..... - .....
Glycerine	lb.	..... -	.20 - .21
Iodine, resublimed	lb.	..... -	4.50 - .....
Iron oxide, red	lb.	..... -	.06 - .08
Iron sulphate, (copperas)	cwt.	1.00 -	1.20 - 1.50
Lead acetate, normal	lb.	..... -	.12½- .14
Lead arsenate (paste)	lb.	..... -	.15 - .17
Lead nitrate, crystals	lb.	..... -	.85 - .86½
Litharge	lb.	..... -	.09½- .10½
Lithium Carbonate	lb.	..... -	1.50 - .....
Magnesium carbonate, technical	lb.	..... -	.13 - .14½
Magnesium sulphate, U. S. P.	100 lb.	2.00 - 2.63	2.75 - .....
Magnesium sulphate	100 lb.	1.75 -	2.00 - .....
Nickel salt, double	lb.	.14 -	.15 - .....
Nickel salt, single	lb.	.12 -	.15 - .16
Phosgene (see carbonyl chloride)	...	..... -	.70 - .....
Phosphorus, red	lb.	..... -	.65 - .....
Phosphorus, yellow	lb.	..... -	.35 - .37
Potassium bichromate	lb.	.25 - .28	.65 - .....
Potassium bitartrate (cream of Tartar)	lb.	..... -	.55 - .60
Potassium bromide, granular	lb.	..... -	.49 - .50
Potassium carbonate, U. S. P.	lb.	.60 -	.65 - .70
Potassium carbonate, crude	lb.	.17 -	.20 - .....
Potassium chlorate, crystals	lb.	.24 -	.27 - .30
Potassium cyanide, 98-99 per cent.	lb.	nominal	
Potassium hydroxide (caustic potash)	lb.	.32 -	.35 - .40
Potassium iodide	lb.	..... -	3.55 - 3.60
Potassium nitrate	lb.	.19 -	.21 - .....
Potassium permanganate	lb.	..... -	.55 - .65
Potassium prussiate, red	lb.	..... -	.90 - 1.10
Potassium prussiate, yellow	lb.	..... -	.50 - .60
Potassium sulphate	ton	225.00 -	..... - .....
Rochelle salts (see sodium potas. tartrate)	...	..... -	..... - .....
Salammoniac (see ammonium chloride)	...	..... -	..... - .....
Sal soda (see sodium carbonate)	...	..... -	..... - .....
Salt cake	ton	17.00 -18.00	..... - .....
Silver cyanide	oz.	..... -	1.19 - .....
Silver nitrate	oz.	..... -	.67½- .68½
Soda ash, light	100 lb.	1.85 - 1.90	2.00 - .....
Soda ash, dense	100 lb.	2.25 -	2.50 - .....
Sodium acetate	lb.	.06 - .07	.07 - .08
Sodium bicarbonate	100 lb.	2.35 -	2.75 - 3.00
Sodium bichromate	lb.	.14½-	.15 - .16
Sodium bisulphate (nitre cake)	ton	3.00 - 8.00	10.00 - .....
Sodium bisulphite	cwt.	1.80 - 1.90	2.00 - 2.10
Sodium borate (borax)	lb.	.07¾-	.08 - .....
Sodium carbonate (sal soda)	100 lb.	1.35 - 1.50	1.50 - 1.75
Sodium chlorate	lb.	.15 -	.16 - .18½
Sodium cyanide	lb.	.30 -	.31 - .34
Sodium fluoride	lb.	.13 -	.14 - .15
Sodium hydroxide (caustic soda)	100 lb.	2.75 -	2.90 - 3.50
Sodium molybdate	lb.	2.50 -	3.25 - .....
Sodium nitrate	100 lb.	3.00 - 3.25	3.75 - 4.00
Sodium nitrite	lb.	.09½- .10	.10½- .13
Sodium peroxide, powdered	lb.	..... -	.30 - .32
Sodium phosphate, dibasic	lb.	.03¾- .04½	.04 - .05
Sodium potassium tartrate (Rochelle salts)	lb.	..... -	.43 - .45½
Sodium prussiate, yellow	lb.	.18 - .18½	.19 - .20
Sodium silicate, solution (40 deg.)	lb.	.01½- .02	.02 - .02½
Sodium silicate, solution (60 deg.)	lb.	.02½-	..... - .04½
Sodium sulphate, crystals (Glauber's salts)	cwt.	1.05 - 1.35	1.50 - 2.00
Sodium sulphide, crystal, 60-62 per cent. (conc)	lb.	..... -	.05 - .06
Sodium sulphite, crystals	lb.	.03½-	.04 - .....
Strontium nitrate, crystals	lb.	.25 -	..... - .28
Sulphur chloride	lb.	.05½-	..... - .06
Sulphur, crude	ton	35.00 -	37.50 - .....
Sulphur dioxide, liquid, cylinders	lb.	..... -	.10 - .12
Sulphur (sublimed), flowers	100 lb.	3.05 -	..... - 3.60
Sulphur, roll (brimstone)	100 lb.	2.70 -	3.65 - .....
Tin bichloride (stannous)	lb.	.48 -	.49 - .50
Tin oxide	lb.	..... -	.60 - .....
Zinc carbonate, precipitate	lb.	..... -	.20 - .....
Zinc chloride, gran.	lb.	.12½-	.13½- .14
Zinc cyanide	lb.	.49 -	.50 - .....
Zinc dust	lb.	.09 - .11	.11 - .14
Zinc oxide, dry American	lb.	..... -	.10 - .13
Zinc sulphate	lb.	.03½-	.04 - .04½

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude	lb.	$1.00 —	$1.10
Alpha naphthol, refined	lb.	1.40 —	1.50
Alpha naphthylamine	lb.	.35 —	.50
Aniline oil, drums extra	lb.	.25 —	.30
Aniline salts	lb.	.28 —	.33
Anthracine, 80% in drums (100 lb.)	lb.	.90 —	1.00
Benzaldehyde (f.f.c.)	lb.	1.00 —	1.15
Benzidine, base	lb.	.95 —	1.15
Benzidine, sulphate	lb.	.90 —	1.10
Benzoic acid, U. S. P.	lb.	1.00 —	1.10
Benzoate of soda, U. S. P.	lb.	.95 —	1.10
Benzol, pure, water-white, in drums (100 lb.)	gal.	.24 —	.28
Benzol, 90%, in drums (100 lb.)	gal.	.23½ —	.27
Benzyl chloride, 95-97%, refined	lb.	.35 —	.40
Benzyl chloride, tech.	lb.	.25 —	.35
Beta naphthol benzoate	lb.	3.75 —	4.50
Beta naphthol, sublimed	lb.	.75 —	.80
Beta naphthol, tech.	lb.	.45 —	.55
Beta naphthylamine, sublimed	lb.	2.25 —	2.35
Cresol, U. S. P., in drums (100 lb.)	lb.	.18 —	.....
Ortho-cresol, in drums (100 lb.)	lb.	.23 —	.25
Cresylic acid, 97-99%, straw color, in drums	gal.	.85 —	.90
Cresylic acid, 95-97%, dark, in drums	gal.	.80 —	.85
Cresylic acid, 50%, first quality, drums	gal.	.60 —	.....
Dichlorbenzol	lb.	.07 —	.10
Diethylaniline	lb.	1.50 —	2.25
Dimethylaniline	lb.	.52 —	.57
Dinitrobenzol	lb.	.25 —	.37
Dinitroclorbenzol	lb.	.25 —	.28
Dinitronaphthaline	lb.	.45 —	.55
Dinitrophenol	lb.	.30 —	.32
Dinitrotoluol	lb.	.38 —	.45
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38 —	.46
Diphenylamine	lb.	.70 —	.75
H-acid	lb.	1.75 —	2.25
Metaphenylenediamine	lb.	1.20 —	1.80
Monochlorbenzol	lb.	.10 —	.14
Monoethylaniline	lb.	1.50 —	1.75
Naphthaline crushed, in bbls. (250 lb.)	lb.	.06 —	.08
Naphthaline, flake	lb.	.06½ —	.07½
Naphthaline, balls	lb.	.08½ —	.10
Naphthionic acid, crude	lb.	.75 —	1.25
Nitrobenzol	lb.	.13 —	.15
Nitro-naphthaline	lb.	.35 —	.45
Nitro-toluol	lb.	.17 —	.20
Ortho-amidophenol	lb.	4.25 —	.....
Ortho-dichlor-benzol	lb.	.15 —	.20
Ortho-nitro-phenol	lb.	.90 —	1.00
Ortho-nitro-toluol	lb.	.27 —	.40
Ortho-toluidine	lb.	.30 —	.45
Para-amidophenol, base	lb.	2.60 —	3.50
Para-amidophenol, HCl	lb.	2.75 —	3.25
Para-dichlor-benzol	lb.	.06 —	.10
Paranitraniline	lb.	1.00 —	1.25
Para-nitro-toluol	lb.	1.35 —	1.50
Paraphenylenediamine	lb.	2.75 —	4.00
Paratoluidine	lb.	1.50 —	1.75
Phthalic anhydride	lb.	1.75 —	2.15
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.10 —	.13
Pyridin	gal.	2.50 —	.....
Resorcin, technical	lb.	3.50 —	3.75
Resorcin, pure	lb.	6.50 —	7.75
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.30 —	.40
Salicylic acid, U. S. P.	lb.	.35 —	.45
Salol	lb.	.80 —	.90
Solvent naphtha, water white, in drums, 100 gal.	gal.	.22 —	.27
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.19 —	.24
Sulphanilic acid, crude	lb.	.25 —	.30

Tolidine	lb.	1.75	—	2.50
Toluidine, mixed	lb.	.45	—	.80
Toluol, in tank cars	gal.	.22	—	.24
Toluol, in drums	gal.	.23	—	.30
Xylidine, drums, 100 gal.	lb.	.44	—	.46
Xylol, pure, in drums	gal.	.37	—	.45
Xylol, pure, in tank cars	gal.	.35	—	.....
Xylol, commercial, in drums, 100 gal.	gal.	.23	—	.27
Xylol, commercial, in tank cars	gal.	.22	—	.....

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow	lb.	$0.44	—	$0.45
Beeswax, refined, yellow	lb.	.48	—	.49
Beeswax, white pure	lb.	.65	—	.68
Carnauba, No. 1	lb.	.88	—	.90
Carnauba, No. 2, regular	lb.	.65	—	.85
Carnauba, No. 3, North Country	lb.	.58	—	.60
Japan	lb.	.18½	—	.21
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.06	—	.....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.06	—	.06½
Paraffine waxes, refined, 118-120 m.p.	lb.	.07½	—	.08
Paraffine waxes, refined, 128-130 m.p.	lb.	.08½	—	.09
Paraffine waxes, refined, 133-135 m.p.	lb.	.10½	—	.11
Paraffine waxes, refined, 135-137 m.p.	lb.	.12	—	.13½
Stearic acid, single pressed	lb.	.25	—	.27
Stearic acid, double pressed	lb.	.28	—	.29
Stearic acid, triple pressed	lb.	.30	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$0.95		
Pine oil, pure, dest. dist.	gal.	.85		
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.45		
Pine tar oil, ref., sp.gr.1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.33		
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.65		
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.34		
Turpentine, crude, sp. gr., 0.900-0.970	gal	.85		
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.27		
Pinewood creosote, ref.	gal.	.48		

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$18.00	—	$18.25
Rosin E-I	280 lb.	18.50	—	20.50
Rosin K-N	280 lb.	21.00	—	24.50
Rosin W. G.-W. W.	280 lb.	23.50	—	25.50
Wood rosin, bbl.	280 lb.	17.70	—	18.00
Spirits of turpentine	gal.	1.75	—	1.80
Wood turpentine, steam dist.	gal.	1.65	—	.....
Wood turpentine, dest. dist.	gal.	1.55	—	.....
Pine tar pitch, bbl.	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	12.75	—	13.50
Retort tar, bbl.	280 lb.	13.75	—	14.50
Rosin oil, first run	gal.	.86	—	.91
Rosin oil, second run	gal.	.88	—	.93
Rosin oil, third run	gal.	.90	—	1.07
Rosin oil, fourth run	gal.	.93	—	1.10

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.33½		
70-72 deg., steel bbls. (85 lb.)	gal.	.31½		
68-70 deg., steel bbls. (85 lb.)	gal.	.30½		
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23½		

Crude Rubber

Para—Upriver fine	lb.	$0.54	—	$0.54½
Upriver coarse	lb.	.31	—	.31½
Upriver caucho ball	lb.	.31	—	.31½
Plantation—First latex crepe	lb.	.41	—	.41½
Ribbed smoked sheets	lb.	.40	—	.40½
Brown crepe, thin, clean	lb.	.34	—	.36
Amber crepe No. 1	lb.	.36	—	.37

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.	lb.	$0.19	—	$0.20
Castor oil, AA, in bbls.	lb.	.21	—	.22
China wood oil, in bbls.	lb.	.22	—	.24
Cocoanut oil, Ceylon grade, in bbls.	lb.	.19½	—	.20
Cocoanut oil, Cochin grade, in bbls.	lb.	.21	—	.22
Corn oil, crude, in bbls.	lb.	.24	—	.25
Cottonseed oil, crude (f.o.b. mill)	lb.	.21	—	.25
Cottonseed oil, summer yellow	lb.	.28	—	.29
Cottonseed oil, winter yellow	lb.	.28	—	.30
Linseed oil, raw, car lots	gal.	2.20	—	2.22
Linseed oil, raw, tank cars	gal.	2.17	—	2.19
Linseed oil, boiled, car lots	gal.	2.24	—	2.25
Olive oil, commercial	gal.	2.30	—	2.50
Palm, Lagos	lb.	.17½	—	.18½
Palm, bright red	lb.	.16½	—	.17½
Palm, Niger	lb.	.16½	—	.17½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.26	—	.27
Peanut oil, refined, in bbls.	lb.	.29	—	.30
Rapeseed oil, refined in bbls.	gal.	1.55	—	1.60
Rapeseed oil, blown, in bbls.	gal.	1.60	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.	lb.	.19½	—	.20
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.16½	—	.17

FISH

Winter pressed Menhaden	gal.	$1.28	—	$1.35
Yellow bleached Menhaden	gal.	1.30	—	1.37
White bleached Menhaden	gal.	1.32	—	1.38
Blown Menhaden	gal.	1.38	—	1.40

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated	ton	$25.00	—	$36.00
Barytes, off color	ton	20.00	—	25.00
Blanc fixe, dry	lb.	.03½	—	.04½
Blanc fixe, pulp	ton	35.00	—	47.50
Casein	lb.	.16	—	.18
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.04½	—	.06
Chalk, English, dense	lb.	.04	—	.05
China clay (Kaolin), imported, lump	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered	ton	25.00	—	40.00
Feldspar	ton	11.50	—	15.50
Fluorspar, acid grade, lump, f.o.b. mines	net ton	$30.00	—	$35.00
Fluorspar, acid grade, ground, f.o.b. mines	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered	ton	30.00	—	40.00
Fuller's earth, imported, powdered	ton	.....	—	.....
Pumice stone, imported	lb.	.03	—	.06
Pumice stone, domestic	lb.	.02½	—	.....
Shellac, TN	lb.	1.10	—	.....
Shellac, D. C.	lb.	.....	—	.....
Shellac, V. S. O.	lb.	.....	—	.....
Shellac, Diamond I.	lb.	.....	—	.....
Shellac, orange, fine	lb.	.....	—	.....
Shellac, orange, superfine	lb.	1.25	—	.....
Shellac, A.C. garnet	lb.	.95	—	.....
Shellac, bleached, bone dry	lb.	1.40	—	.....
Shellac, bleached, fresh ground	lb.	1.10	—	.....
Soapstone	ton	15.00	—	25.00
Talc, domestic	ton	16.00	—	60.00
Talc, imported	ton	55.00	—	60.00

Refractories

Following prices are f.o.b. works:

Chrome brick	net ton	90-100 at Chester, Penn.
Chrome cement	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay	net ton	35-45 at Clearfield, Penn.
Clay brick, 2nd quality	net ton	30-35 at Clearfield, Penn.
Magnesite, dead burned	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4½ x 2½ in.	net ton	80-90 at Chester, Penn.
Silica brick	net ton	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$250.00	—	.....
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon	lb.	.30	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon	lb.	.70	—	.....
Ferro-manganese, 70-80% Mn	gross ton	100.00	—	125.00
Spiegeleisen, 16-20% Mn	gross ton	30.00	—	50.00
Ferro-molydenum, per lb. of Mo	lb.	1.85	—	2.00
Ferro-silicon, 50%	gross ton	85.00	—	115.00
Ferro-silicon, 75%	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	1.30	—	1.60
Ferro-uranium, 35-50% of U	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	5.50	—	7.00

Resales and overstocks make above prices approximate.

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr_2O_3	unit	$0.60	—	
Chrome ore, 48% and over	unit	.80	—	
Coke, foundry, f.o.b. ovens	net ton	5.50	—	$6.00
Coke, furnace, f.o.b. ovens	net ton	4.00	—	5.00
Petroleum coke, refinery, Atlantic seaboard	net ton	11.50	—	12.00
Fluorspar, gravel, f.o.b. mines	net ton	20.00	—	25.00
Manganese ore, 45% Mn and over	unit	.50	—	.65
Manganese ore, chemical (MnO_2)	gross ton	60.00	—	70.00
Molybdenite, 85% MoS_2, per lb. of MoS_2	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO_3 and over per unit of WO_3	unit	9.00	—	12.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3	unit	7.00	—	10.00
Uranium oxide, 96%	lb.	.....	—	.....
Vanadium pentoxide, 99%	lb.	6.00	—	.....
Pyrites, foreign, lump	unit	.15	—	.....
Pyrites, foreign, fine	unit	.15	—	.....
Pyrites, domestic, fine	unit	.14	—	.17½
Ilmenite, 50% TiO_2	net ton	30.00	—	.....
Rutile, 95% TiO_2	net ton	200.00	—	.....
Carnotite, minimum 2% U_3O_8, per lb. of U_3O_8	lb.	2.75	—	3.00

Resales and overstocks make above prices approximate.

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags	bbl.	$2.30
Lump lime, common, including container	300 bbl.	2.65
Common brick, at dock	M.	15.00
Hollow building tile, 8x12x12	M.	194.40
At factory, Perth Amboy, N. J. 12x12x12	M.	291.60
Yellow pine, 3x4 to 8x8, 20-24 ft. long	M.	40.00
Yellow pine, 3x4 to 8x8, 20-24 ft. long at Chicago	M.	39.50
Yellow pine, 3x4 to 8x8, 20-24 ft. long at St. Louis	M.	37.00
Roofings, tar felt (14 lb. per 100 sq.ft.)	ton	60.00
Roofings, tar pitch (in 400-lb. bbl.)	ton	21.00
Roofings, asphalt pitch	ton	34.00
Roofings, asphalt felt	ton	63.00
Roofings, slate-surfaced, per roll of 108 sq.ft.		2.00
Roofings, slate-finished shingles, 100 sq.ft.		5.00
Linseed oil, raw in barrels	gal.	2.15
Linseed oil, 5 gal. cans	gal.	2.28
Red lead, dry, 100 lb. keg	lb.	.13
Red lead, in oil, 100 lb. keg	lb.	.14½
Red lead, dry, 5 lb. cans	lb.	.15
Red lead, in oil, 5 lb. cans	lb.	.16½
White lead, dry and in oil, 100 lb. keg	lb.	.13
White lead, dry and in oil, 25 and 50 lb. kegs	lb.	.13½
White lead, dry and in oil, 5 lb. cans	lb.	.15

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.	100 lb.	$2.45
Angles, 3 to 6-in., ¼-in. thick	100 lb.	2.45
Tees, 3-in. and larger	100 lb.	2.45
Plates	100 lb.	2.66
Rivets, structural, ½-in. and larger	100 lb.	4.20
Rivets, conehead for boilers, ½-in. and larger	100 lb.	4.30
Sheets, No. 28 black	100 lb.	4.35
Sheets, No. 10 blue annealed	100 lb.	3.55
Sheets, No. 28 galvanized	100 lb.	5.70

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

JOHNSON—The Mines & Development Corp. has taken over the Arizona-Michigan property here and plans to improve same and also build a 50-ton concentrator.

California

REDLANDS—The University of Redlands has awarded the contract for the construction of a 2-story, 60 x 120-ft. Science Hall, including laboratories, etc., to W. C. Crowell, 440 Chamber of Commerce Bldg., Pasadena.

Connecticut

HARTFORD — The Hartford Rubber Works, Bartholomew Ave., plans to erect a 6-story, 100 x 300-ft. addition to its factory. Lockwood, Greene & Co., 60 Federal St., Boston, Mass., engineer.

MANCHESTER—The Orford Soap Co., Hilliard St., plans to build a factory addition, including a grinding mill. Estimated cost, $40,000.

STAMFORD—The city plans to build a sewage disposal plant. Estimated cost, $225,000.

STRATFORD—The city has awarded the contract for the construction of a sewage disposal plant, chlorine-treatment house, tidal basin, sludge bed, etc., to the Eastern Engineering & Construction Co., 886 Main St., Bridgeport. Estimated cost, $175,000.

Kansas

GALENA—The Silver Fox Lead & Zinc Co. plans to build a new mill to replace the one destroyed by fire on June 29 and is in the market for entire concentrating plant equipment. F. Childress, general manager.

Maryland

TOWSON—The Commissioners of Baltimore County will receive bids until Aug. 18 for the construction of a sewage disposal plant, Imhoff tanks, dosing chamber, trickling filters, etc. Estimated cost, $100,000. Norton, Bird & Whitman, 606 Munsey Bldg., Baltimore, engineers.

Massachusetts

PROVINCETOWN — The East Harbor Fertilizer Co., 293 Bridge St., Springfield, plans to construct a 2-story, 70 x 75-ft. fertilizer plant. Estimated cost, $30,000. C. N. Flagg Co., Springfield, engineer.

WILLIMANSETT (Holyoke P. O.)—The Paper Makers Chemical Co., 529 Main St., has awarded the contract for the construction of a 1-story factory, to P. J. Kennedy & Co., Inc., 464 Maple St., Holyoke. Estimated cost, $75,000.

Michigan

DETROIT—The city plans to construct the Conners Creek sewerage system on Conners Rd.; treatment works to comprise a battery of 40 Imhoff tanks. Estimated cost, $14,000,000. C. W. Hubbell, City Hall, engineer.

DETROIT—The Fisher Body Corp., Piquette Ave., has awarded the contract for the construction of a 6-story, 156 x 551-ft. paint shop on Piquette Ave and St. Antoine St., to H. G. Christman Co., 315 Stevens Bldg. Estimated cost, $1,200,000. Noted Aug. 1.

Minnesota

ADRIAN—The city is having surveys made by Druar & Smith, engineers, Globe Bldg., St. Paul, for the construction of a new sewerage system and a disposal tank. Estimated cost, $40,000. M. E. Corrigan, village clerk.

ITKIN—L. Hallem, city commissioner, is receiving bids for installing one purifier, one water filter, one 150-hp. Corliss type steam engine, one electric generator, 125 kw current, one coal conveyor and 50,000-gal. steel or wood water tank.

ROCHESTER—F. A. Bricker and G. J. Pattison, Fargo, N. D., and A. C. Fawcet, Rochester, plan to build a 5-story, 46 x 142-ft. dental clinic. Estimated cost, $300,000.

Missouri

CAMERON—The city will soon award the contract for the construction of a filtration plant. Estimated cost, $35,000. E. E. Harper, 2408 East 30th St., Kansas City, engineer. Noted May 15.

DUENWEG—The M. & T. Mining Co. plans to move its mill from Granby District and erect same here, and is in the market for boiler, steam engine and compressor rolls. R. McGee, general manager.

MILAN—The city will soon award the contract for the construction of complete sanitary sewers and a disposal plant. Estimated cost, $40,000. Archer & Stevens, New England Bldg., Kansas City, engineers.

ST. LOUIS—The American Syrup Preserving Co., East Union Ave. and Terminal R. R., has awarded the contract for the construction of a 1-story, 55 x 70-ft. factory at 5125 Penrose Park, to B. J. Charleville, 810 Chestnut St. Estimated cost, $5000.

Montana

HELENA—The State Board of Health plans to build a laboratory. Estimated cost, $50,000.

SCOBEY—The City Council will soon award the contract for the construction of sanitary sewers, manholes, settling tank and sludge beds. Estimated cost, $45,000. W. B. Sanders, Helena, engineer.

Nebraska

HARVARD—The city plans to construct sanitary sewers and a sewage disposal plant. Estimated cost, $50,000. Grant, Fulton & Letton, 505 Bankers' Life Bldg., Lincoln, engineers.

New Jersey

NEWARK—The Max Hertz Leather Co is having plans prepared for the construction of a 3-story, 42 x 200-ft. factory addition on Oliver St. Estimated cost, $150,000. James A. Pigott, 9 Clinton St., engineer.

NEWARK—The Radell Leather Co. has had plans prepared for the construction of a 1-story, 50 x 60-ft. factory addition on Wilson Ave. Estimated cost, $10,000. J. A. Pigott, 9 Clinton St., engineer.

PLEASANTVILLE—The city has awarded the contract for the construction of a sanitary sewerage system, to Edwin G. Britz, 1759 Park Ave., New York City. Estimated cost, $86,310.

TRENTON—The Albano Manufacturing Co., manufacturer of shoe paste, 701 Cass St., has awarded the contract for the construction of a 1-story, 50 x 90-ft. factory, on Oakland Ave., to Samuel Tietz, 469 Brunswick Ave. Estimated cost, $14,890. Noted July 1.

TRENTON—The Trenton Electric & Conduit Co., 3 Tyler St., plans to construct a 2-story plant for the manufacture of porcelain. Estimated cost, $10,000.

WESTMONT—The city has awarded the contract for the construction of a 9-mile sanitary sewerage system, etc., to W. Penn Corson, 1141 Sycamore St., Camden, at $68,416. Noted July 1.

New York

KINGS PARK—The State Hospital Commission, Capitol, Albany, received bids for the construction of a sewage disposal plant, at Kings Park State Hospital, from Ganford Co., Inc., 503 5th Ave., $8,320; New York Sewage Disposal Co., 37 East 28th St., $8,650; Slattery Engineering & Construction Co., Inc., 7 East 42nd St., $10,799; contractors all of New York City. Noted Aug. 1.

SYRACUSE—The Board of Education of Onondaga plans to erect a 2-story, 150 x 200-ft. school. A chemical laboratory will be installed in same. Estimated cost, $350,000. Ford, Buck & Sheldon, 68 Prospect St., Hartford, Conn., engineers.

SYRACUSE—The N. L. Oberdorfer Brass Co., 804 East Water St., will receive bids until Aug. 25 for the construction of a 1-story brass foundry on Water St. Estimated cost, $40,000. Melvin L. King, Snow Bldg., engineer.

WEST ENDICOTT (Endicott P. O.)—The Endicott Johnson Co., Johnson City, plans to erect a 3-story concrete tannery and a 4-story concrete shoe factory at West Endicott. Estimated cost, $350,000.

Ohio

ALLIANCE—The city will hold an election Sept. 8, to vote on $525,000 bonds for the erection of a gas plant.

CLEVELAND—The Atlantic Foundry Co., 7510 Morgan Rd., has awarded the contract for the construction of a 1-story, 26 x 36-ft. addition, to Bolton & Pratt Co., 801 Columbia Bldg. Estimated cost, $5000. Noted Aug. 1.

CLEVELAND — The Cleveland Fruit Juice Co., 1390 West 9th St., plans to build a 3-story, 100 x 140-ft. factory on Euclid Ave. and London Rd. Estimated cost, $80,000.

CLEVELAND—The Cuyahoga Galvanizing Co., 1280 East 59th St., plans to construct a 1-story, 60 x 100-ft. factory at 3352 Payne Ave. Estimated cost, $10,000.

CLEVELAND—The Glidden Varnish Co., Madison Ave. and Berea Rd., is having plans prepared for the construction of a 4-story 59 x 90-ft. grinding building on Madison Ave. Estimated cost, $60,000. Osborn Engineering Co., 2848 Prospect Ave., engineer.

CLEVELAND—The Orth Brass & Aluminum Castings Co., 1378 East 33rd St., plans to build a 2-story, 34 x 78-ft factory. Estimated cost, $10,000.

TOLEDO—The City Council is having plans prepared for the installation of twenty-two new filters of 1,000,000-gal. daily capacity, a 20 x 150 x 500-ft settling basin of 11,250,000-gal. capacity and several miles of 30, 32 and 40 in. C. I. mains. Bonds for $850,000 have been voted for project. H. C. McClure, 229 Valentine Bldg., engineer.

Oklahoma

DOUTHAT—The Dudley Milling Co. plans to erect a tailing mill to treat tailings from Admiralty No. 2 and is in the market for a gas engine, rolls, jig-irons, elevator pulleys and belts. C. Theuer, supt.

EL RENO—The City Clerk will soon receive bids for enlarging the sewerage system and Imhoff sewage disposal plant. Estimated cost, $95,000. H. G. Powel, Box 204, engineer.

HARTSHORNE—The city plans an election Sept. 2 to vote on bonds for the construction of a water purification plant. V. V. Long & Co., Oklahoma City, consulting engineer.

HOCKERVILLE—The Hope Lead & Zinc Co. plans to move the old Scott Eagle Mill from Quapaw and erect same here, and is in the market for gas engines, compressor and tables. W. Benton, supt.

PICHER—W. & H. Logan & Co., Hockerville, plans to move the old Coronet Mill from north of Blue Mound to Picher, and is in the market for tables, rolls, shafting, pulleys and belting. F. Sleck, general manager.

ST. LOUIS—The Underwriters Land Co., Picher, plans to erect a complete new concentrating plant at their No. 4 shaft, and is in the market for entire equipment for same. F. N. Bendelari, general manager.

STROUD—The city is having plans prepared by Johnson & Benham, engineers, Firestone Bldg., Kansas City, Mo., for laying 28,000 ft. of sewers and installing Imhoff tank. Estimated cost, $95,000

Oregon

BEND—The Oregon Nitrate Co. plans to develop Stinking Lake and Sheep Mountain nitrate deposits by installing crystallization evaporating system and crushing plant. Estimated cost, $25,000. J. H. Morgan, Bend, president.

Pennsylvania

FARMERVILLE—Morris Knowles, engineer, Jones-Law Bldg., Pittsburgh, has awarded the contract for the construction of a sewage disposal plant for the Consum-

ers Mining Co., to Pihl & Miller, Wabash Bldg. Estimated cost, $10,000. Imhoff tanks will be installed in same.

PHILADELPHIA—The Philadelphia Paper Manufacturing Co., 231 South Front St., has awarded the contract for the construction of a 1-story, 55 x 192-ft. factory on Nixon and Fountain Sts., to the Brown Construction Co., 4600 Main St. Estimated cost, $25,000.

PHILADELPHIA—Powers, Weightman & Rosengarten Co., 916 Parrish St., has awarded the contract for the construction of a 5-story chemical factory, to R. C. Ballinger & Co., 218 North 13th St. Estimated cost, $45,000.

PITTSBURGH—The United Engineering & Foundry Co. is having preliminary plans made for the construction of a 2-story, 45 x 100-ft. foundry and office buildings on 54th St. Hunting-Dans Co., Century Bldg., architect.

SCRANTON—The Heath Silk Co. plans to construct a 3-story, 50 x 100-ft. silk mill on Wyoming Ave. Estimated cost, $66,000. G. N. Edson, Connell Bldg., architect.

Rhode Island

PAWTUCKET—The Halliwell Co., Blackstone Ave., has awarded the contract for the construction of a 2-story, 60 x 105-ft. addition to its bleachery, to the Cruise & Smiley Construction Co., 188 Main St. Estimated cost, $40,000.

PROVIDENCE—The U. S. Gutta Percha Co., 12 Dudley St., has awarded the contract for the construction of a 5-story, 50 x 100-ft. steel addition to its plant, to Williams & Merchant, Inc., 86 Weybosset St. Estimated cost, $80,000.

EL PASO—The city plans an election to vote on $100,000 bonds for the construction of a septic tank.

STRAWN—The Palo Pinto Oil Co., 61 Broadway, New York City, has awarded the contract for the construction of a gasoline extraction plant to Westinghouse, Church, Kerr & Co., 37 Wall St., New York City. Estimated cost, $50,000.

Utah

SALT LAKE CITY—Headlund & Kent, engineers, Dooley Bldg., will soon award the contract for the construction of a 10-ton oil distilling plant for the Rainbow Petroleum Oil Products Co. Estimated cost, $25,000.

Washington

SPOKANE—The Shell Oil Co., of California, North 111 Green St., plans to enlarge its plant here. Estimated cost, $100,000.

SPOKANE—The Spokane Drug Co., 707 Railroad Ave., plans to build a 5-story, 116 x 142-ft. drug factory on Wall St. and Railroad Ave. Estimated cost, $200,000.

West Virginia

PARKERSBURG—The city has awarded the contract for the construction of a crib filter at the filtration plant, to the Western Rivers Co., Point Pleasant. Estimated cost, $20,545. The city will furnish necessary cast iron pipe.

Ontario

BRANTFORD—The Brantford Smelting Co. has awarded the contract for the construction of a 100 x 200-ft. tin smelting plant, to P. H. Secord, 133 Nelson Ave. Estimated cost, $50,000.

KINGSTON—The Department of Public Works, Ottawa, has awarded the contract for the construction of a sewage system and disposal works at the Sydenham Military Hospital, to W. H. Harvey, Kingston. Estimated cost, $10,403.

KITCHENER—The Canadian Consolidated Rubber Co., 137 King St., plans to construct a 4-story rubber factory at 149 Strange St. Estimated cost, $1,000,000.

LONDON—C. S. Hyman Co., Ltd., Richmond St., will soon award the contract for the construction of a 5-story, 150 x 300-ft. tannery on St. George St. Estimated cost, $300,000. H. C. McBride, Molsons Bank, architect. Noted July 15.

LONDON—The McClary Manufacturing Co., 333 Wellington St., manufacturer of enamelware, tinware, etc., plans to build a 5-story, 72 x 120-ft. addition to its factory. Estimated cost, $60,000. J. M. Moore, 425 Richmond St., architect.

SAULT STE. MARIE—The Algoma Steel Co. plans to build a 1-story structural steel plant. Estimated cost, $300,000.

WINDSOR—The city has had plans prepared by F. W. Thorold, engineer, 167 Avenue Rd., Toronto, for the construction of a pumping station and filtration plant for the border cities of Windsor, Sandwich, Walkerville, etc. Estimated cost, $100,000.

Cuba

HAVANA—The Air Reduction Co., 120 Broadway, New York City, has awarded the contract for the construction of a 2-story, 98 x 108-ft. acetylene plant, to Hamilton & Chambers, 29 Broadway, New York City. Estimated cost, $100,000.

Coming Meetings and Events

THE AMERICAN CERAMIC SOCIETY will hold a meeting in Chicago, Sept. 24.

THE AMERICAN CHEMICAL SOCIETY will hold its Fall meeting in Philadelphia, Pa., Sept. 2-6 inclusive.

THE AMERICAN ELECTROCHEMICAL SOCIETY will hold its Fall meeting in Chicago, Sept. 23-25 inclusive.

THE AMERICAN FOUNDRYMEN'S ASSOCIATION will hold its 1919 convention in Philadelphia, Sept. 29 to Oct. 4.

THE AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition of gas appliances and apparatus at the Hotel Pennsylvania, New York, Oct. 13 to 18.

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its Fall meeting in Chicago, Ill., Sept. 22-27.

THE AMERICAN STEEL TREATERS' SOCIETY will hold its first annual convention in Chicago, Ill., Sept. 22-27.

THE FIFTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES will be held in Chicago, Ill., Sept. 22-27 inclusive.

THE INSTITUTE OF METALS DIVISION of the A. I. M. E. will hold its next meeting in Philadelphia, Pa., Sept. 29 to Oct. 4.

THE INSTITUTE OF METALS will hold its Autumn meeting in Sheffield, England, Sept. 24-25.

THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its Fall meeting in Chicago from Sept. 24 to 27.

Industrial Notes

THE MCGRAW-HILL BOOK CO. celebrated its 10th anniversary on July 1, 1919, and issued a booklet entitled "10 Years." For over 20 years prior to July 1, 1909, the Book Department in the McGraw Publishing Co. and the Hill Publishing Co. has been producing books in very special fields. The consolidation has resulted in "better books in text and manufacture," as well as in greatly increased prestige and service. From 200 titles 10 years ago, the list has grown to approximately 1000. Sales during the war were unusually large owing to the demand for highly specialized engineering books. Under special contracts with the Navy Department the Company produced 20 new texts for the aviation and submarine sections. For the Khaki University 1500 packing cases containing 150,000 books were shipped overseas.

THE SOCIETE DE VALEURS POUR FERS ET ACIER (Society for Values of Iron and Steel) in Schaffhausen, Switzerland, reports Consul General L. J. Keena at Zurich has established in Zurich a metallurgical exchange, the purpose of which is to bring together every Friday buyers and sellers of machines of every description and of all kinds of metals used in the manufacture of machinery. The exchange solicits the membership of foreign engineers and exporters of raw materials and calls particular notice to the advantages which a foreign member will have in the marketing of his products in Switzerland by visiting the exchange and bringing his business to the attention of manufacturers desiring to import. The fee for such membership is $5 a year.

ARTHUR D. LITTLE, INC., Cambridge, Mass., announces the resignation of vice-president Mr. Harry S. Mork, who has been elected to the vice-presidency of the Lustron Co. of Boston. This concern manufactures artificial silk by a process developed in the Little Laboratories.

THE PORTABLE MACHINERY CO., Passaic, N. J., has issued a circular entitled "We Welcome Fair Competition." It briefly describes how one concern has kept and is trying to market an imitation of the Scoop conveyor. A suit is pending for infringement of rights and purchasers are warned against the imitation.

THE ELECTRIC FURNACE CONSTRUCTION CO., Finance Bldg., Philadelphia, Pa., has received orders for Greaves-Etchells electric furnaces from the Sullivan Machinery Co. and the Imperial Japanese Mint; the latter is for the manufacture of coinage bronze.

THE CUTLER-HAMMER MFG. CO., Milwaukee, Wis., has opened offices at 905 Kresge Bldg., Detroit, Michigan. Mr. H. S. Kinsley is in charge and has taken with him from the Chicago office Messrs. C. W. Greenman and M. Dugliss, both of whom were recently mustered out of the service.

THE CHICAGO PNEUMATIC TOOL CO., Chicago, Ill., announces the appointment of Mr. N. S. Thulin as special railroad representative on the staff of Mr. S. C. Sprague, manager of Western railroad sales. It is also announced that the Minneapolis office of this company will move to Fifth Avenue and Fifth Street South.

Stocks and Bonds

Closing Bid and Asked Quotations Aug. 13, on N. Y. Stock Exchange

CHEMICAL COMPANIES

	Bid	Ask		Bid	Ask
Am.Ag.Ch....	102	102½	Mat.Al.Wk..	31	33
do.pf.....	98	100	Ten. C. & C.	13½	14
Barrett Co....	120	122	Un. Dyewood	...	...
do.pf.....	110	114½	do.pf.....	...	...
Gen. Chem...	170	190	Va.-Car.Ch...	82½	82½
do.pf.....	103	107½	do.pf.....	113	114
Int.Ag.Ch....	29	29½			
do.pf.....	84½	85½			

Bonds

Am. Ag. Ch., 1st cv. 5s, '28.....	93	110
Am. Ag. Ch., cv. db. 5s, '24.....	103	109½
Int. Ag. Ch., 1 mtg. & col. tr. 5s, '32....	84	84½
Va.-Car. Ch., 1 mtg. 5s, '23.....	95½	95½
Va.-Car. Ch., cv.db. 6s, '24.....	102½	103

PETROLEUM COMPANIES

	Bid	Ask		Bid	Ask
Asso. Oil Co..	80	92	P-A Pet & Tr	109½	109½
Cal. Pet.....	47	47½	do. pf.....	...	...
do. pf.....	83½	84	Pierce Oil....	21½	21½
Col. G. & E..	59½	59½	Royal Dutch.	89½	90
Mex. Pet.....	176½	177½	Sinclair O&R.	55½	56
do. pf.....	107	115	Texas Co....	255	258
Ohio Cit. Gas.	53½	53½	Tex. Pac. Ld. Tr.....	360	465
do. pf.....	...	...			
Ohio Fuel S...	51	51½	Tidewater Oil	240	245
Okla. P. & R.	10½	10½			

Bonds

Columbia Gas & Electric, 1 5s, '27.....	90½	90½
Col. G. & El., std. 1 5s, '27.....	90½	90½
Pan-Am. Pet. & Tr. 1 6s, '19-'27.....	130	...
Pierce Oil, cv. db. 6s, '24.....	104½	105
Pierce Oil, cv. 5% Notes, '20.....	105½	120
Sin. O. & R. 1 1n. 7s, '20, with stk. war..	...	...
Sin. O. & R. 1 1n. 7s, '20 without stk war.	...	...
Texas Co., db. 6s, '31.....	102½	103
Union Oil of Cal. 1 5s, '31.....	94½	95
United Fuel Gas 1 mtg. 6s, ser. A., '36...	94½	98

IRON AND STEEL SECURITIES

	Bid	Ask		Bid	Ask
Am. St. F....	42½	43	Pitts. Ste. pf.	95	97
Beth. Steel...	84	86½	Rep. Iron & Steel.....	88½	89
do. class B..	86½	86½	do. pf.....	104½	105
do. pf., 8%.	112½	114	Sloss Sheff. I. & S.....	64	64½
do. pf., 7%.	106	109	do. pf.....	88	92
Central Fdry.	35½	36	Superior Steel	39½	41
do. pf.....	65	68½	do. 1 pf....	105	...
Col. F. & I...	45	45½	Trans. & W. Steel.....	58	59
do. pf.....	...	...	Un. Alloy St.	51	52
Cruc. Steel...	36½	37	U.S.C.I.P.&F.	35	35½
do. pf.....	...	...	do. pf.....	67	70
Great No. Ore	43½	44	U. S. Steel...	103½	103½
Gulf Sta. Steel	59	61	do. pf.....	115	115½
do. 1 pf.....	94	98	Va. Coal,I&C	61	64
Lack. Steel...	81	81½			
Mid.St.&Ord..	51	51½			
Nova Scotia Steel.....	78	81			

Bonds

Beth. Steel, 1 ext. gtd. S.F. 5s, '26.....	96	96½
Beth. Steel, 1 1n. ref. 5s, Ser. A, '42.....	...	88½
Beth. Steel, P. M. & I. S. F. 5s, '36.....	85½	85½
Buff & Susq. Iron, 1 S. F. 5s, '32.....	90	93½
Buff & Susq. Iron, deb. 5s, '27.....	...	...
Cent. Found, 1 mtg. S. F. 6s, '21.....	85	88½
Col. F. & I., gn. S. F. 5s, '43.....	90½	92
Ill. Steel, db. 4½s, '40.....	84½	84½
Ind. Steel, 1 mtg. gtd. 5s, '52.....	95½	96½
Lack. Steel, 1 5s, '23.....	96½	98
Lack. Ste., 1 con. mtg. cv. 5s, Ser. A, '50.	93½	95
Mid. St. & Ord., clt. cv. S. F., 5s, '36....	87	88
Nat. Tube, 1 mtg. gtd. 5s, '52.....	94	96½
Rep. I. & S., S. F. mtg., 5s, '40.....	93½	93½
Tenn. C. & I. R.R. gn. 5s, '51.....	90	...
U. S. Steel, S. F. 5s, 63.....	100½	100½
Va. C., I.& C. 1 5s, '49.....	84	85½